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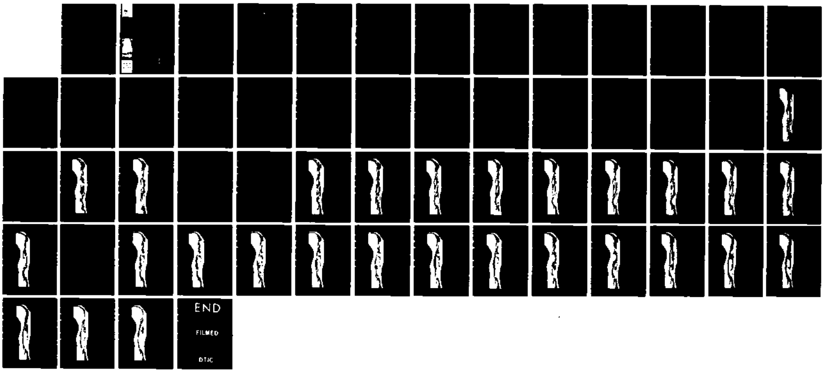

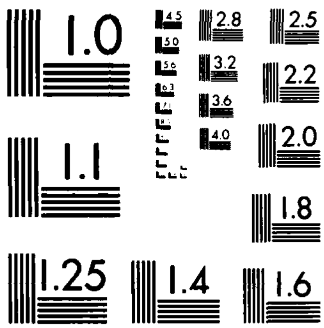

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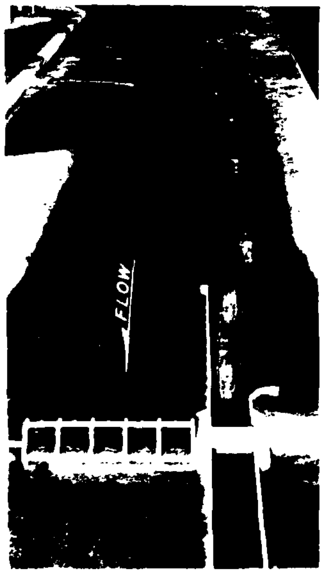

HYDRAULICS
LABORATORY

TECHNICAL REPORT HL-85-2

BUCK ISLAND REACH, MISSISSIPPI RIVER

Hydraulic Model Investigation

by

Charles R. Nickles, Thomas J. Pokrefke, Jr.,
J. Edwin Glover

Hydraulics Laboratory

DEPARTMENT OF THE ARMY
Waterways Experiment Station, Corps of Engineers
PO Box 631
Vicksburg, Mississippi 39180-0631

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This investigation is one phase of a general model study to determine the effectiveness of dike systems proposed for improvement of troublesome reaches on the Mississippi River. This report describes and gives results of tests concerned with the development of plans for the improvement of the Buck Island reach of the river, which is located about 700 river miles above Head of Passes. A movable-bed model reproducing approximately 12.5 miles of

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20. ABSTRACT (Continued).

the Mississippi River to a horizontal scale of 1:300 and a vertical scale of 1:100 with crushed coal as the bed material was used to develop plans that would improve and stabilize the navigation channel through the reach and eliminate or reduce the need for maintenance dredging.

The Buck Island reach is a straight reach of river where dike fields have been constructed to form a sinuous navigation channel. During the Mississippi River flood of 1973, failure of two dikes resulted in the forming of a new smaller channel that was not deep enough to allow navigation during low flows. Conditions produced by the new channel made it difficult for tows to navigate the reach, especially during low-flow periods. Plans tested in the model study included improvement and stabilization of the prefailure navigation channel alignment and realignment of the reach to eliminate the crossings.

Model results indicated that the original channel alignment could be restored by rebuilding Buck Island dikes 3 and 4; however, some dredging may be required near Commerce Bend. With the addition of two dikes to the original plan above the Basket Bar dikes, some channel improvement on low flows was indicated, although flood flows may continue to shoal at the head of Commerce Bend. Shoaling at Commerce Bend could be reduced by constructing dikes from either the right bank or by extending and adding dikes on the left bank.

The reach could be realigned by using either spur or vane dikes. The realigned channel would be easier to navigate and would be more stable during flood flow conditions. Training the flow to follow this alignment would require dredging in addition to the construction of spur dikes. Development of the realignment with vane dikes indicated less construction and maintenance dredging than the spur dike plan. Reconstruction of the existing alignment (Plan A) would require fewer structures than any realignment plan (Plans B through E). During flood years, the existing alignment could be maintained providing that Buck Island dikes 3 and 4 do not fail. The realignment channel would be less likely to be affected by floods and somewhat easier to navigate because of the fewer number of crossings in the reach.

PREFACE

The model investigation reported herein was conducted for the US Army Engineer District, Memphis (LMM), in the Inland Waterways Research Facility of the Hydraulics Laboratory of the US Army Engineer Waterways Experiment Station (WES), Vicksburg, Mississippi. The Inland Waterways Research Facility is coordinated by the Lower Mississippi Valley Division (LMVD) and jointly funded by LMM, the US Army Engineer District, Vicksburg, the US Army Engineer District, New Orleans, and the US Army Engineer District, St. Louis, to study troublesome reaches of the lower Mississippi River.

The investigation was conducted during the period April 1977-December 1980 under the general supervision of Messrs. H. B. Simmons, Chief of the Hydraulics Laboratory, WES, and under the direct supervision of J. E. Glover, Chief of the Waterways Division. The engineer in immediate charge of the investigation was Mr. T. J. Pokrefke, Jr., who was assisted by Messrs. C. R. Nickles, R. K. Anglin, D. M. Maggio, W. L. Higdon, and R. R. Henderson. This report was prepared by Messrs. Nickles, Pokrefke, and Glover.

During the course of the model study, LMM and LMVD were kept informed of the progress of the study through monthly progress reports and interim test results. Messrs. Bobby Littlejohn, Don Jackson, Steve Smith, Jerry Branum, Frank Novitzki, and Andy Lowery of LMM made frequent visits to WES to observe model tests, discuss test results, and coordinate the testing program. Visits were also made at intervals by Messrs. Max Lamb, Jimmie Graham, Jim Tuttle, George Kerr, and Bill Pinner of LMVD to observe model tests and discuss test results.

Commanders and Directors of WES during the conduct of the test and the preparation and publication of this report were COL John L. Cannon, CE, COL Nelson P. Conover, CE, COL Tilford C. Creel, CE, and COL Robert C. Lee, CE. Technical Director was Mr. F. R. Brown.

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CONVERSION FACTORS, US CUSTOMARY TO METRIC (SI) UNITS OF MEASUREMENT

US customary units of measurement used in this report can be converted to metric (SI) units as follows:

Multiply	By	To Obtain
cubic feet per second	0.02831685	cubic metres per second
degrees (angle)	0.01745329	radians
feet	0.3048	metres
inches	25.4	millimetres
miles (U. S. statute)	1.609344	kilometres

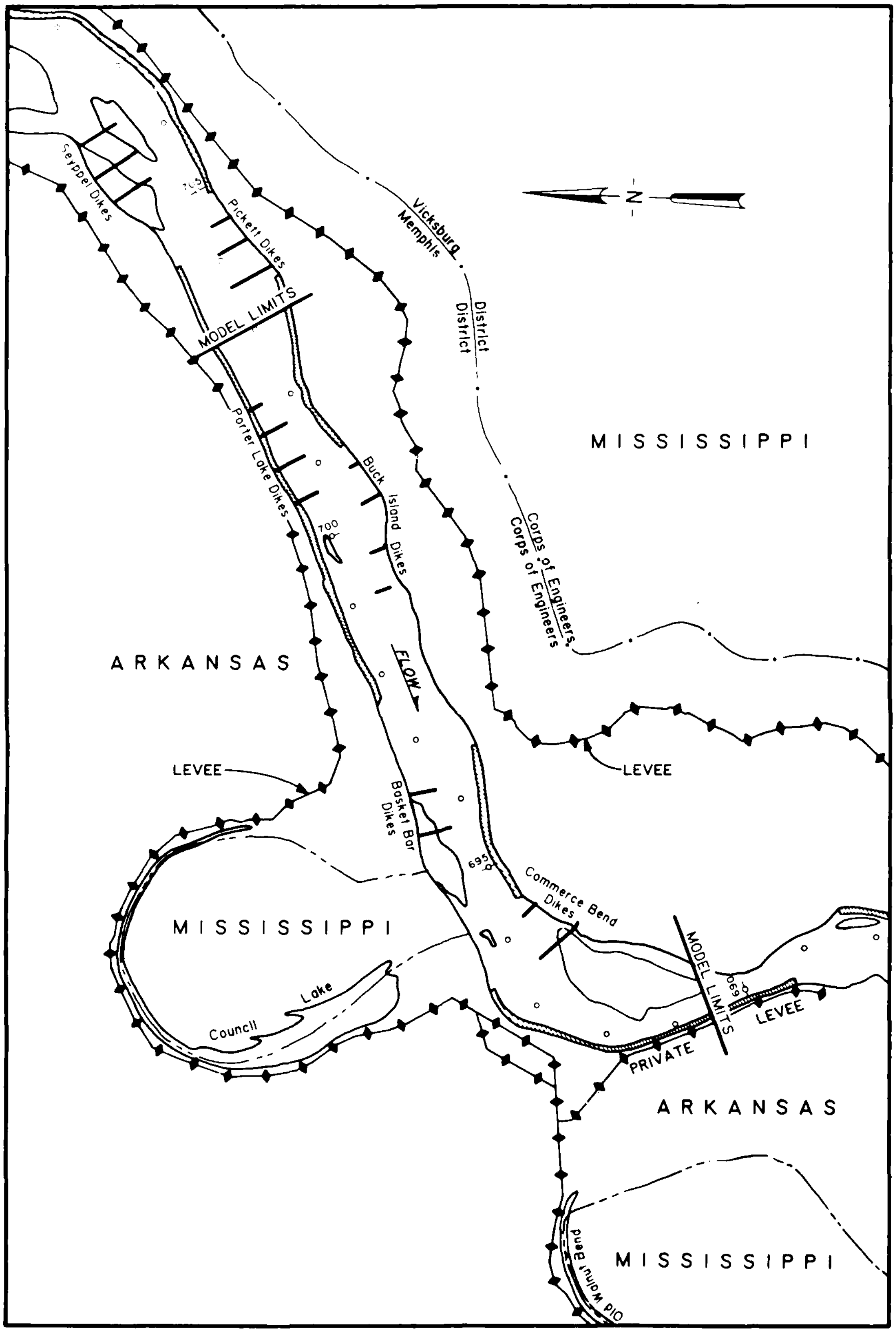

Figure 1. Location map

BUCK ISLAND REACH, MISSISSIPPI RIVER

Hydraulic Model Investigation

PART I: INTRODUCTION

1. This report presents the results of a movable-bed model investigation concerned with the development of plans for the improvement of Buck Island reach. Plans tested were proposed by the US Army Engineer District, Memphis (LMM), in collaboration with representatives of the US Army Engineer Waterways Experiment Station (WES), and were designed to develop a stable navigation channel through the reach.

Description of the Problem

2. The Buck Island reach of the Mississippi River is a straight reach of river where dike fields have been constructed to form a sinuous navigation channel. The reach is located approximately halfway between Memphis, Tennessee, and Helena, Arkansas. During the Mississippi River flood of 1973, failure of the lower two Buck Island dikes (Figure 1) resulted in the forming of a new smaller channel that remained along the left bank and crossed back to the right bank near the Basket Bar dike field; however, the new channel was not deep enough to allow navigation during low flows. Conditions produced by the new channel made it difficult for tows to cross from the left to the right bank near Buck Island dike 4, then back to the left bank near the Basket Bar dike field.

Purpose of the Model Study

3. Plans were proposed by LMM for the improvement and stabilization of the existing navigation channel alignment and realignment of the channel to eliminate two crossings. Because of the complex nature of the reach and the processes involved in its development, the model study was undertaken to obtain some indication of the effectiveness of the proposed dike systems to maintain the existing alignment and the feasibility of a channel realignment, and to develop any modifications that might be required.

PART II: THE MODEL

Description

4. The movable-bed model used for this study reproduced to a horizontal scale of 1:300 and a vertical scale of 1:100 the reach of Mississippi River between miles 690.5 and 703.0,* which is a sufficient section of the river above and below the problem area to study all proposed plans. The scales selected resulted in a distortion of the linear scale of 3, which is acceptable for a model of this type. Crushed coal of specific gravity of 1.30 and a median grain size of about 4 mm was used for the bed material. The bank lines and dikes were constructed of 3/4-in.** crushed stone sprinkled with cement. The model study was conducted in the Inland Waterways Research Facility flume. Water to the flume was supplied by a 10-cfs pump in a recirculating system and was measured with 12- × 6- and 6- × 3-in. venturi meters. Flow through the venturi meters was controlled by pneumatic valves. Water-surface elevations in the flume were controlled by a vertical slide-type gate and measured by point gages and LD-101 Sonic Liquid Level Detectors.

Model Verification

5. Before tests of improvement plans were undertaken, adjustments were made until the model reproduced, to a reasonable degree of accuracy, changes that have occurred in the prototype. This process is referred to as model verification. The verification process establishes the discharge scales, rate of introducing bed material for each flow reproduced, supplemental slope required to produce movement of the bed material, model operating technique, and accuracy to which the model reproduces prototype conditions.

6. Verification of the model was started with the channel portion molded to the conditions indicated by the June 1976 prototype survey and the overbank molded to conditions indicated by Geological Survey Quadrangle maps of the area (Plate 1). The model was then operated by reproducing flow that occurred in the river during the period 2 June 1976 to 16 May 1977 (Plate 2).

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* River miles above Head of Passes.

** A table of factors for converting US customary units of measurement to metric (SI) units is presented on page 3.

The operation was repeated and adjustments were made until the model reproduced with reasonable accuracy the essential characteristics of the reach and channel configurations indicated by the May 1977 prototype survey (Plate 3).

7. Results of the final adjustment test shown in Plate 4 indicate that the model reproduced the general characteristics of the prototype reach, and the verification was considered adequate for the purpose of the study. Comparison of the results of the model verification with the prototype survey of May 1977 (Plate 3) indicates that the model had a greater tendency to shoal near the ends of Porter Lake dikes 3 and 4, with the channel from the beginning of the model to near Porter Lake dike 2 being deeper and narrower than the prototype. The channel near the Basket Bar dikes was somewhat deeper. The model also showed the tendency for less shoaling in the right channel at Buck Island dike 4, with the channel (miles 697 to 699) to the left of Buck Island dike 4 being somewhat shallower than the prototype. These differences and tendencies have to be considered in the evaluation of the results of the test of improvement plans. For a detailed description of the verification process, see WES Instruction Report H-78-1.*

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* J. J. Franco. 1978 (Aug). "Guidelines for the Design, Adjustment and Operation of Models for the Study of River Sedimentation Problems," Instruction Report H-78-1 (includes Appendixes A-C), US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

PART III: TEST AND RESULTS

Test Procedure

8. After verification of the model, testing was conducted to determine channel development with one or more reproductions of an annual average hydrograph and to provide a basis for comparing the effects of various improvement plans. The average annual hydrograph used for the testing of most plans was furnished by LMM (Plate 5). Various plans were also subjected to one or more reproductions of the Mississippi River flood hydrograph of 1973 (Plate 6) to determine the effect of flood flows on channel stability. Each reproduction of the average annual or 1973 flood hydrographs is herein referred to as a "run." Most of the tests of improvement plans or modifications were started with the bed configuration of the model in the same condition as that obtained at the end of the preceding test. Other tests were started with the bed molded to the May 1978 or February 1979 prototype surveys (Plates 7 and 8, respectively). The bed of the model was surveyed and mapped at the end of each run. Only final results or significant changes produced by each plan or modification are included in this report.

Base Test

Description

9. A base test was conducted to obtain an indication of future development of the channel existing at the time of the May 1978 prototype survey. Since the May 1978 prototype survey was a high-water survey, it was also desirable to project the short-term channel development to the low-water period when dike construction is normally accomplished. The base test was started with the bed of the model molded to the condition indicated by the May 1978 prototype survey, and the model was subjected to the portion of the average annual hydrograph from the date of the prototype survey to the end of August. The model was surveyed and operation resumed using the average annual hydrograph. The hydrograph was repeated four times.

Results

10. Results of the base test after four runs, shown in Plate 9,

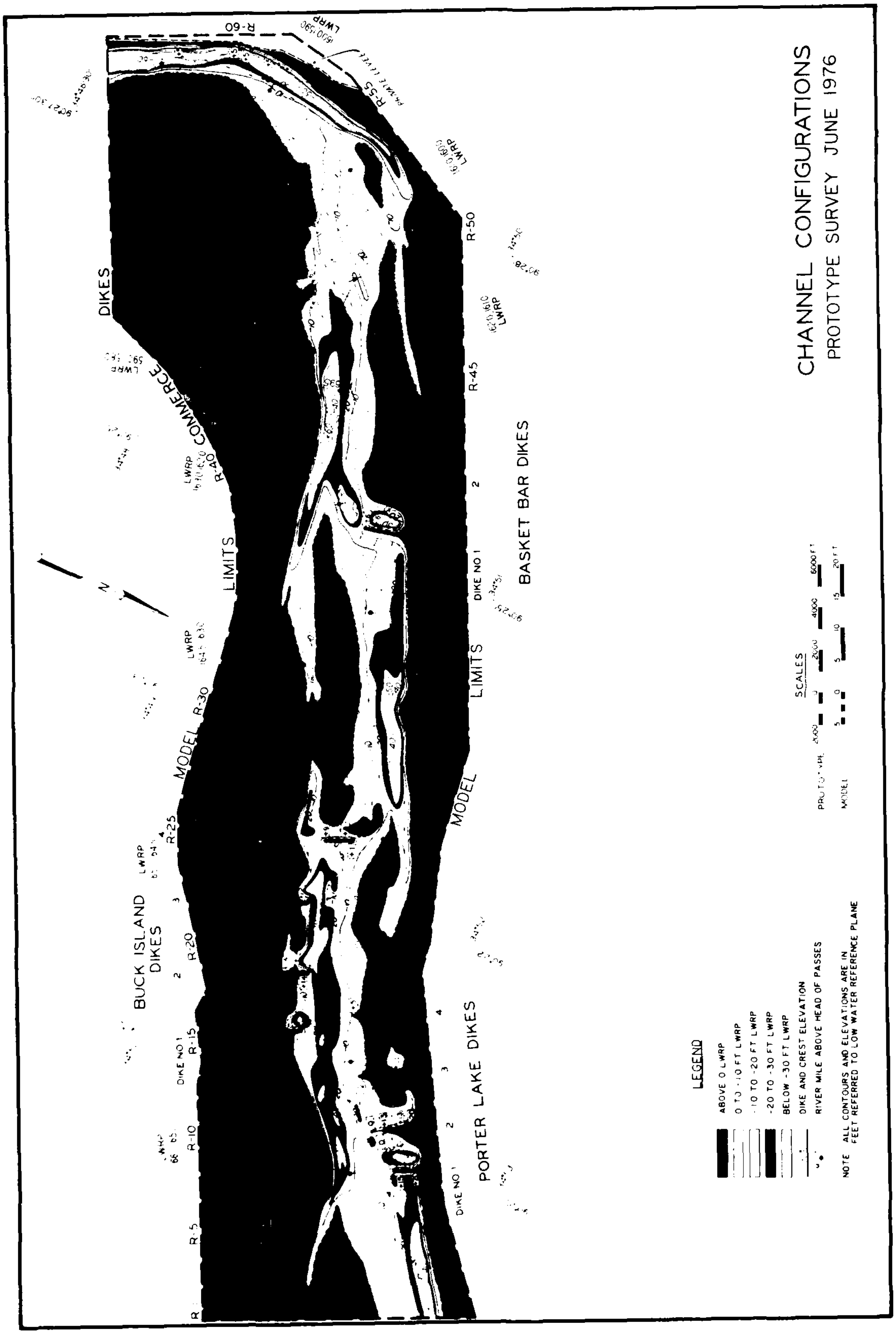
CHANNEL CONFIGURATIONS
PROTOTYPE SURVEY JUNE 1976
LEGEND
ABOVE 0 LWRP
0 TO -10 FT LWRP
-10 TO -20 FT LWRP
-20 TO -30 FT LWRP
BELOW -30 FT LWRP
DIKE AND CREST ELEVATION
RIVER MILE ABOVE HEAD OF PASSES
NOTE ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO LOW WATER REFERENCE PLANE
SCALES
PROTOTYPE
MODEL
COMMERCE DIKES
MODEL LIMITS
MODEL LIMITS
BUCK ISLAND DIKES
PORTER LAKE DIKES
BASKET BAR DIKES
DIKE NO 1
N
R-5
R-10
R-15
R-20
R-25
R-30
R-40
R-45
R-50
R-55
R-60
LWRP

PLATE 1

A-5). Constricting the channel from the left would require the thalweg to be shifted to the right and the constricting structures would be subjected to heavy current attack. Structures from the right would not cause the channel to be shifted and current attack would be less.

d. Realignment of the channel in the Plan B and C series eliminated two channel crossings in the reach. The realigned channel would be easier to navigate and would be more stable during flood flow conditions. Training the flow to follow this alignment would require dredging in addition to the construction of spur dikes.

e. Four additional spur dikes extending from the right bank between the Porter Lake and Basket Bar dike fields would be required to maintain the Plan B, C, and D alignment.

f. Dredging a pilot cut along the alignment would produce a channel of sufficient depth, but flow would be divided around a middle bar between the spur dikes and the proposed alignment (Plan B-7). Removal of all material above el -15 near Porter Lake dike 4 produced a wider channel, but some additional maintenance dredging could be required to fully develop the channel along the proposed alignment (Plan C-2).

g. The channel could be realigned by using vane dikes (Plan E) without the dredging required with the spur dikes in Plan C. The vane dikes improved the channel to the left of Buck Island dike 4 and caused shoaling of the upstream end in the right channel.

h. A dike connecting the downstream vane, Plan E-1, to the right bank decreased the flow in the channel along the right bank and the thalweg progressed downstream along the proposed realignment without the need of a pilot cut. As the thalweg shifted toward the left, shoaling occurred along the face of the vane dike system.

i. The radius of Commerce Bend was increased with the Plan E-2 realignment. The smoother curve of the bend was more efficient for navigation and passage of flood stage discharges.

j. The two spur dikes placed on the left bank upstream of the Commerce Bend dikes (Plan E-2) increased the depth of the channel leading into Commerce Bend but had very little effect on the alignment into the bend.

k. Reconstruction of the existing alignment (Plan A) would require fewer structures than any realignment plan (Plans B through E). During flood years, the existing alignment could be maintained providing that Buck Island dikes 3 and 4 do not fail. The realigned channel would be less likely to be affected by floods and somewhat easier to navigate because of the fewer number of crossings in the reach.

PART IV: DISCUSSION OF RESULTS AND CONCLUSIONS

Interpretation of Model Results

54. In analysis and evaluation of the results of this study, the limitations of the model should be considered based on the model verification, base test, hydrographs used, and condition of the model bed at the time that a plan or modification was installed. During verification, the model showed a tendency to increase shoaling near the ends of the Porter Lake dikes and to develop a somewhat deeper channel in the area of the Basket Bar dikes compared with the prototype. The model also showed the tendency for less shoaling in the right channel at Buck Island dike 4. These tendencies should be considered in the evaluation of the model results. Tests of improvement plans should be based on only those changes caused by these plans compared with the results reproduced in the model during the verification. It should also be considered that the model does not reproduce the movement of material in suspension, and the bank lines were fixed, with no attempt made to reproduce the degree of erodibility of the banks and sandbars. Also to be considered are the average annual and 1973 flood hydrographs used for testing of plans, which could be considerably different from what actually occurs in the river in the future, and the fact that the model surveys were always made during the low-water period.

Summary of Results and Conclusions

55. The following results and general indications were developed from the model study:

- a. Rebuilding of Buck Island dikes 3 and 4 (Plan A) would restore the channel to its alignment prior to the flood of 1973. The channel at the Basket Bar dikes was narrow and poorly aligned. Some maintenance dredging would be required near the head of Commerce Bend during extremely low stages.
- b. Construction of two dikes upstream of Basket Bar dike 1 (Plan A-1) decreased the attack on Basket Bar dike 1 and somewhat improved the channel depths entering Commerce Bend. Maintenance dredging could be required after flood stages at the head of Commerce Bend, depending on the flow conditions following the flood stages.
- c. Shoaling of the channel at Commerce Bend could be reduced by constructing dikes from either bank of the river (Plans A-2 and

Basket Bar dike field were somewhat less than the channel in the remainder of the navigation channel.

Plan E-2

50. Description. Plan E-2 consisted of the addition of spur dikes 1U and 2U on the left, upstream of the Commerce Bend dikes, to Plan E-1. The purpose of this plan was to decrease the length of the crossing at the Basket Bar dikes to provide a wider channel of navigation depth and a smoother transition into Commerce Bend. The dikes were constructed at miles 695.1 and 694.7 at el +16 and el +14, respectively. The proposed stabilization alignment began at the channel end of Basket Bar dike 2, then curved to the right overbank and tied in to the existing revetment at mile 693.1. The proposed alignment was stabilized in the model with a trench-filled rock revetment to prevent the bank scouring beyond the proposed alignment. Testing was undertaken with the channel configuration existing at the end of Plan E-1, run 8.

51. Results. Plate 31 shows the plan and the results of two runs. Results indicate that the channel alignment in the bend was smoother, but that the thalweg would not move far enough to the right to follow the proposed alignment. The smoother bend was more efficient for navigation and passage of flood flows. The channel ends of the new dikes took a heavy current attack, but there was no significant change in the channel upstream of the dikes.

Plan E-3

52. Description. Plan E-3 was the same as Plan E-2 except that the Commerce Bend dike 1U was sloped up from the stream end at el +14 for 800 ft to el +16, than tied in to the bank at el +16.

53. Results. The plans and results after two runs, shown in Plate 32, indicated that there were no significant changes in the channel depth or alignment produced by the raising of the dike crest elevation.

constructed downstream of the L-head between miles 698.9 and 697.3. Each vane was 1,000 ft long and built to el +15. The spacing between the L-head dike and the first and second vanes was approximately 500 ft. The spacing between the remaining vanes was 750 ft. The spacing and angle of the vanes were designed to produce shoaling in the channel crossing near Buck Island dike 4 and to move the channel to the left toward the proposed alignment.

47. Results. After two runs, results indicated that the crossing upstream of Buck Island dike 4 would begin to close off and some shoaling occurred to the left of the vane dikes. The plan and results after five runs, shown in Plate 27, showed that upstream of Buck Island dike 4 the crossing would close and the thalweg moved to the left but crossed back to the right at vane dike 1. There was a definite tendency for a channel to form to the left of the vane dikes with shoaling occurring in the channel along the right bank upstream of Basket Bar dike 1. However, the division of flow at vane dike 1 hampered the development of the left channel.

Plan E-1

48. Description. Plan E-1 was designed to decrease flow to the right channel and to improve the development of the left channel. The plan consisted of Plan E with the addition of an L-head dike extending from the right bank at mile 697.2. The dike was 3,750 ft long and the L-head was 1,000 ft long. The entire dike was built at crest el +13. The L-head was at an angle of about 10 deg to the direction of flow to aid the effect of the vanes. The starting bed configuration was that obtained at the end of Plan E, run 5 (Plate 27).

49. Results. The thalweg progressed downstream along the proposed alignment with each run and shoaling occurred along the face of the vane dike. After the sixth run, a good navigation channel was produced throughout the model except for an area between miles 695 and 696 where depths were shallow enough to cause problems for navigation during extremely low stages (Plate 28). The plan was then subjected to a run of the 1973 flood hydrograph followed by a run of the typical hydrograph. Results of these runs, Plates 29 and 30, indicated that the channel alignment was not affected nor did the navigation channel shoal as a result of the higher stages and discharges of the flood hydrograph. The channel continued to deepen along the proposed alignment during the succeeding typical hydrograph producing a channel of el -10 or below throughout the model reach. The channel depth and width in the area of the

in Plate 25, indicated that the channel would divide around the remaining portion of Buck Island dike 4 and the channel would be too shallow to allow navigation. There was no tendency for the channel to scour along the proposed alignment.

Plan D-1

43. Description. Plan D-1 was the same as Plan D except Buck Island dike 4 was extended to the right bank and an L-head was added to the channel end of the dike. The L-head was 1,000 ft long and was angled downstream at an angle of approximately 80 deg to the alignment of the dike. The entire dike and L-head were constructed at crest el +15. Testing of Plan D-1 was initiated with the bed configuration obtained at the end of Plan D, run 3 (Plate 25).

44. Results. The plan and results after two runs on Plan D-1, shown in Plate 26, indicated that the channel would shift slightly toward the left at Buck Island dike 4, but would make a shallow crossing sharply back to the right immediately downstream of the dike. It was evident from these results that dikes similar to those of the Plan C series would be required to move the channel to follow the proposed alignment; therefore testing of the plan was discontinued.

Plans E, E-1, E-2, and E-3

45. The E-series of plans was designed to realign the channel along the same alignment described in Plan D using vane dikes instead of spur dikes. Some additional modifications were made to the entrance to the model to more closely reproduce the prototype flow conditions that were induced upstream of the reach being modeled. A dike approximately 3,700 ft long at el +13 (Pickett dike 3) was constructed on the approach apron at mile 702.5. Porter Lake dike 2 was shortened approximately 50 ft and Porter Lake dike 4 was extended approximately 325 ft at el +5. These additional modifications were necessary to more closely reproduce the effects of the point bar and dikes upstream of the model. Before Plan E was installed, the model was remolded to the prototype conditions shown by the 1979 prototype survey (Plate 8).

Plan E

46. Description. Plan E consisted of removing Buck Island dikes 1, 2, and 3 and the construction of a 1,000-ft L-head dike described in Plan D-1 to the left end of Buck Island dike 4 at el +15. Five vane dikes were

indicated that the thalweg would be unchanged and the bar along the left bank would continue to increase in elevation and extend downstream.

Plan C-2

39. Description. Plan C-2 was a continuation of Plan C-1 with a pilot dredge cut added through the bar along the left bank between miles 699.5 and 698.5. The cut was approximately 300 ft in bottom width, with bottom el -15 and approximately 7,500 ft in length. The dredge cut extended from approximately mile 699.3 downstream to mile 697.9.

40. Results. Results after two runs, with the pilot cut being redredged after the first run, indicated that the bar along the left bank would be small and that the thalweg would begin to shift toward the proposed realignment. Plate 23 shows the results after a third run without additional dredging. Results indicated that the bar would be eliminated and that shoaling occurred along the channel ends of Porter Lake dike 5A and Buck Island dike 4. A good navigation channel of el -10 or below was produced along the proposed channel alignment. Plate 24 shows the results of a 1973 prototype flood hydrograph following Plan C-2, run 3. Results indicated that the channel was not affected by a flood hydrograph and the shoaling along the end of the dikes con .nued. A typical hydrograph following the flood hydrograph showed that the trends of the model continued. The shoaling at the dikes continued to increase and the channel continued to deepen along the left bank.

Plans D and D-1

Plan D

41. Description. Plan D was a slightly different proposed realignment plan from Plans B and C. For Plan D, Buck Island dikes 2 and 3 were removed completely, dike 1 was shortened approximately 375 ft, and dike 4 was returned to its prototype length and elevation. The proposed realignment was shifted to the left to align with the channel end of Buck Island dike 1, then curved into the left overbank to tie in to the proposed alignment of Plans B and C at approximately mile 698. It then followed the same alignment downstream as Plans B and C. The bed was remolded to the conditions of the 1979 prototype survey (Plate 8) before testing of Plan D. All other previously proposed dikes were removed.

42. Results. The plan and results after three runs on Plan D, shown

end of Plan B-5, and the remaining portion of the model remained as was obtained at the end of Plan B-7, run 3 (Plate 19).

34. Before test of Plan C was undertaken, some adjustments were made at the entrance to the model to decrease the tendency of the model to shoal more than the prototype in the area of Porter Lake dikes 3 and 4. This tendency was noted during model adjustment and verification but its effect on the channel development was not fully appreciated. During verification of the model, the higher elevation of shoaling in the model along the point bar at the ends of Porter Lake dikes 3 and 4 caused a shorter channel crossing from the right bank to the left bank at mile 701.5 than was indicated by prototype surveys and was believed to be the reason for the crossing from Buck Island dike 2 to the channel end of Porter Lake dike 5A in the Plan B test. The adjustment consisted of extending the fixed model approach apron downstream to Porter Lake dike 1 to prevent the erosion of the midbar at mile 702 and shortening the channel ends of Porter Lake dikes 1 and 2 by about 300 ft and 200 ft, respectively. Four runs of the typical hydrograph were made during this adjustment period to obtain the initial bed configuration at which to begin testing Plan C (Plate 20).

Plan C

35. Description. Plan C consisted of the same dike fields as in Plan B-7 plus the dredging of all material above el -15 between the proposed realignment and the thalweg of the existing channel between miles 700.0 and 697.0. The plan and bed configuration for Plan C are shown in Plate 20.

36. Results. Results after two runs, shown in Plate 21, indicated that the thalweg would cross sharply from the left at Buck Island dike 2 to the right at Porter Lake dike 5A, then recross the channel to the left bank at Basket Bar dike 1. A large bar was formed between miles 699.5 and 698.5 along the left bank that would limit navigation during extremely low flows. Some shoaling occurred downstream of Buck Island dike 4 and the scour hole at the channel end of the dike was decreased considerably.

Plan C-1

37. Description. Plan C-1 was the same as Plan C except Porter Lake dike 2 was shortened approximately 300 ft to provide a longer crossing at mile 701.5. The beginning bed configuration was the same as that at the end of Plan C, run 2.

38. Results. Results after one run on Plan C-1, shown in Plate 22,

channel between the Buck Island and Basket Bar dikes. A new channel was formed along the stream ends of Buck Island dike 4 and Basket Bar dikes 1U and 2U. This channel was sufficient to allow navigation but did not follow the proposed new alignment. The dredge cut of Plan B-6 produced a navigation channel of approximately 300 ft in width along the proposed alignment, but the material between the dredge cut and the channel produced by Plan B-5 was not eroded but formed two middle bars. The downstream middle bar at mile 698.3 remained at an elevation high enough to present an obstruction to navigation for all flows of bank-full or below. The channel of Plan B-5 remained open and was deeper and wider than the channel along the proposed alignment obtained with Plan B-6.

Plan B-7

31. Description. Plan B-7 consisted of Plan B-6 and the degrading of the channel end of Buck Island dike 2 to el -30. The bed configuration at the end of Plan B-6 was used as beginning conditions for Plan B-7. The dredge cut in Plan B-6 was redredged for Plan B-7.

32. Results. The plan and results after two runs, shown in Plate 18, indicated that a single middle bar was formed with a channel along the proposed alignment deep enough to allow navigation. The middle bar was about 20 ft lower in elevation than that in Plan B-6. Although flow was divided by the middle bar, this plan produced a navigation channel of 500 ft or wider along the proposed realignment. Plate 19 shows the results of one run of the 1973 flood hydrograph on the bed configuration after Plan B-7, run 2 (Plate 18). Results indicated that the channel to the left of the middle bar increased slightly in width and the middle bar continued to degrade. The channel to the right of the middle bar showed the tendency to shoal. The navigation channel above and below the middle bar was unchanged by the flood hydrograph.

Plans C, C-1, and C-2

33. The Plan C series consisted of the same channel realignment as the Plan B series. The dikes in the model were the same as those in Plan B-5. For the Plan C series, the model was remolded from the head of the model to mile 700.0 to the channel configuration of the 1979 prototype survey (Plate 8), from mile 700.0 to mile 697.2 to the channel configuration obtained at the

overbank, and reenter the existing channel on the left bank near Basket Bar dike 2. The realigned channel would eliminate the channel crossings between Buck Island dikes 2 and 4 (mile 699.5) and at Basket Bar dike 1 (mile 696.5). The alignment would increase the lengths of the river crossings and provide a smoother alignment into Commerce Bend.

Plans B through B-6

29. Description. Before Plan B was installed, the model was molded to the conditions of the February 1979 prototype survey (Plate 8). Since the prototype survey was a high-water survey, the typical hydrograph was run from the date of the survey to low water before Plan B was installed. Revetment was placed along the proposed alignment to prevent the model from scouring beyond the proposed alignment. Plans B through B-6 were a progressive series of spur dikes or dredge cuts designed to train the flow along the proposed alignment. Each succeeding plan was installed with the bed configuration existing at the end of the previous plan. Plans B through B-6, shown in Plate 17, consist of the following:

Plan	Description
B	Buck Island dike 2 was lowered beginning at the dike spur riverward approximately 850 ft to el -15. Buck Island dike 3 was lowered to el -15.
B-1	A spur dike, Porter Lake dike 5A, was constructed from the right bank at mile 699.7. The dike was approximately 3,500 ft long at crest el +15.
B-2	An L-head was added to Porter Lake dike 5A at crest el +15. The L-head was 1,000 ft long and was angled downstream at an angle of approximately 80 deg to the alignment of dike 5A.
B-3	Buck Island dike 4 was extended to tie in to the right bank. The entire dike was raised to el +13.
B-4	A spur dike, Basket Bar dike 1U, was constructed from the right bank at mile 696.9. The dike was approximately 3,500 ft long at el +10.
B-5	A spur dike, Basket Bar dike 2U, was constructed from the right bank at mile 697.9. The dike was approximately 4,200 ft long at el +11.5.
B-6	A dredge cut was made along the proposed alignment from mile 697.5 to mile 700.0. The dredge cut had a bottom width of 300 ft at el -20.

30. Results. Plan B did not affect the alignment of the existing channel. The dikes of Plans B-1 through B-5 closed off the existing right bank

construction of a new dike (1U) approximately 2,400 ft upstream of Commerce Bend dike 1 (mile 694.6). The dike was approximately 800 ft long with a crest elevation of +17. The channel end of the dike was positioned to provide a smooth transition from the revetment line upstream to the channel end of the extension to Commerce Bend dike 1. Plan A-5 was installed in the bed configuration obtained at the end of one run of Plan A-4.

Results

24. Results of one run of Plan A-3 indicated that the channel at Commerce Bend would move slightly toward the right between miles 693 and 694. The channel end of the extension to Commerce Bend dike 2 received severe attack with a deep scour hole being formed at the end of the extension. Shoaling occurred in the dredge cut immediately downstream of the extension and in the area near the channel end of dike 1. The channel above Commerce Bend remained stable with a good channel of el -10 throughout the reach.

25. Results of one run of Plan A-4 indicated that the channel continued to widen and move toward the right. The attack on dike 2 was somewhat less, with the scour hole at dike 1 enlarging slightly. This plan produced a good channel of el -20 or below throughout the reach.

26. The plan of the complete sequence (Plan A-5) and results after two runs are shown in Plate 15. The channel remained about the same except for some slight deepening of the channel along the left bank between miles 694 and 696. Deep scour holes were formed at the stream ends of Commerce Bend dikes 1 and 1U. This plan produced a good navigation channel throughout the model.

27. The final sequence was subjected to two runs of the 1973 flood hydrograph to determine an indication of the effect of floods on the channel. Results after the second run of the flood hydrograph are shown in Plate 16. Results indicated that the channel at Commerce Bend would remain stable with the scour holes at dikes 1 and 1U enlarging somewhat. The navigation channel of el -10 or below would be maintained throughout the modeled reach.

Plans B through B-7

28. Plans B through B-7 were a progressive series of tests to realign the channel from mile 696.0 to mile 700.3 from the right bank to the left bank. The new alignment would leave the existing channel at the end of the crossing at Buck Island dike 2, then continue on a smooth curve into the left

Results

18. Results after two runs indicated that a wider channel of el -10 or deeper would develop in the Commerce Bend area, with little change in the alignment of the navigation channel. Results after three runs, shown in Plate 14, indicated that the channel would continue to deepen slightly with no significant change in its width or alignment.

19. Results obtained at the end of two consecutive 1973 flood hydrographs indicated that during periods of high stages, slight shoaling of the channel at Commerce Bend could be expected.

Plans A-3, A-4, and A-5

Description

20. Plans A-3, A-4, and A-5 were a sequence of extensions and additions to the Commerce Bend dikes. The sequence was designed to move the channel at Commerce Bend toward the right bank. Moving the channel to the right would provide a longer upstream crossing and a smoother transition into the bend.

21. Plan A-3 consisted of Plan A-1 and a 1,700-ft extension to Commerce Bend dike 2. The extension was angled upstream normal to the flow, approximately 30 deg to the alignment of the existing dike. To reduce the effect of the abrupt change in channel width, the extension was originally constructed to a crest elevation of +5, then raised to its final crest elevation of +14 after the initial low-water stages of the hydrograph. The model was molded to the channel configuration at the end of Plan A-1, run 2 (Plate 12) except for a pilot dredge cut 300 ft wide and approximately 8,000 ft long between miles 693 and 694.5. The pilot cut was dredged to el -15 with the dredged material placed immediately downstream of Commerce Bend dike 2 at a maximum elevation of 0.

22. Plan A-4 was the same as Plan A-3 except for a 900-ft extension to Commerce Bend dike 1. This extension was angled upstream about 30 deg to the existing alignment of the dike. As in Plan A-3, the extension was originally constructed to el +5, then raised to its final grade of el +16 after the low-flow portion of the hydrograph. Plan A-4 was installed in the model bed configuration obtained at the end of one run of Plan A-3, and the pilot cut in Plan A-3 was redredged to el -15.

23. Plan A-5 was the final step of the sequence. It consisted of the

a smooth transition from the discontinuity in the right bank line (mile 697.8) to the channel end of Basket Bar dike 1. Dike 1U was located approximately 3,000 ft upstream, and dike 2U was located approximately 6,000 ft upstream of the Basket Bar dikes. Dike 1U was approximately 1,100 ft long, constructed to el +16; dike 2U was approximately 600 ft long, constructed to el +5. Plan A-1 was installed with the bed configuration as obtained at the end of Plan A, run 2 (Plate 11).

Results

15. Plate 12 shows Plan A-1 and the bed configuration obtained after the second run of the typical hydrograph. Results indicated that a continuous channel of el -10 or below could be maintained throughout the reach. The two added dikes reduced the scour at the end of Basket Bar dike 1, but deep scour pockets formed at the end of these dikes. The channel at Commerce Bend would be relatively wide and shallow but of sufficient depth to allow navigation during low flows. Results of a third run indicated that the scour around the new dikes would remain and the channel at Commerce Bend would remain stable.

16. After run 3, the model was subjected to two consecutive 1973 flood hydrographs to obtain an indication of the stability of the channel during high-water years. Results after the second flood hydrograph, shown in Plate 13, indicate the channel to be stable with some shoaling occurring near the Commerce Bend dikes.

Plan A-2

Description

17. Plan A-2 consisted of the addition of three dikes to Plan A-1 along the right bank across from the Commerce Bend dikes. The purpose of the plan was to deepen and improve the alignment of the channel at Commerce Bend and to reduce the tendency of shoaling of the area during periods of high stages. The three dikes are called Peters Landing dikes 1, 2, and 3. Dike 1 was constructed at mile 694.2 and was approximately 1,450 ft long at el +16; dike 2 was constructed at mile 693.8 and was approximately 1,250 ft long at el +15; and dike 3 was constructed at mile 693.3 and was approximately 1,250 ft long at el +14. The model bed was remolded to the configuration at the end of Plan A-1, run 2 (Plate 12) for testing Plan A-2.

indicated that a channel at or below el -10* existed throughout the reach. The crossing near the Basket Bar dikes remained poorly aligned with flow entering the channel from the left. This would present problems for navigation during midbank flows and below. Shoaling occurred near the ends of Porter Lake dikes 3 and 4, forcing the thalweg against Buck Island dikes 1 and 2.

11. It should be kept in mind that the developments during this test were the results of an average hydrograph with very few flows bank-full or above. Also the effects of any additional dike failure in the prototype would not be indicated by the model since all dikes were fixed and not allowed to change in length or elevation.

Plan A

Description

12. Before Plan A was installed in the model, the bed was remolded to the May 1978 prototype survey and the 1978 hydrograph was run to low-water conditions in August (Plate 10). Plan A consisted of rebuilding Buck Island dikes 3 and 4 to their original alignment and elevation. Dike 3 was constructed to el +12. The existing portion of dike 4 remained at el +8 to +9, and the rebuilt section sloped from el +9 to +25 and then to +29 at the bank.

Results

13. Results of tests of Plan A after two runs, shown in Plate 11, indicated a continuous channel at or below el -10 through the reach except at the channel crossing near the Commerce Bend dikes. The crossing at the Basket Bar dikes remained poorly aligned and narrow.

Plan A-1

Description

14. Plan A-1 was designed to relieve the pressure on Basket Bar dike 1 by increasing the length of the crossing at the dike field. The plan was the same as Plan A except for the construction of two additional dikes upstream of Basket Bar dike 1. The channel ends of the dikes were constructed to provide

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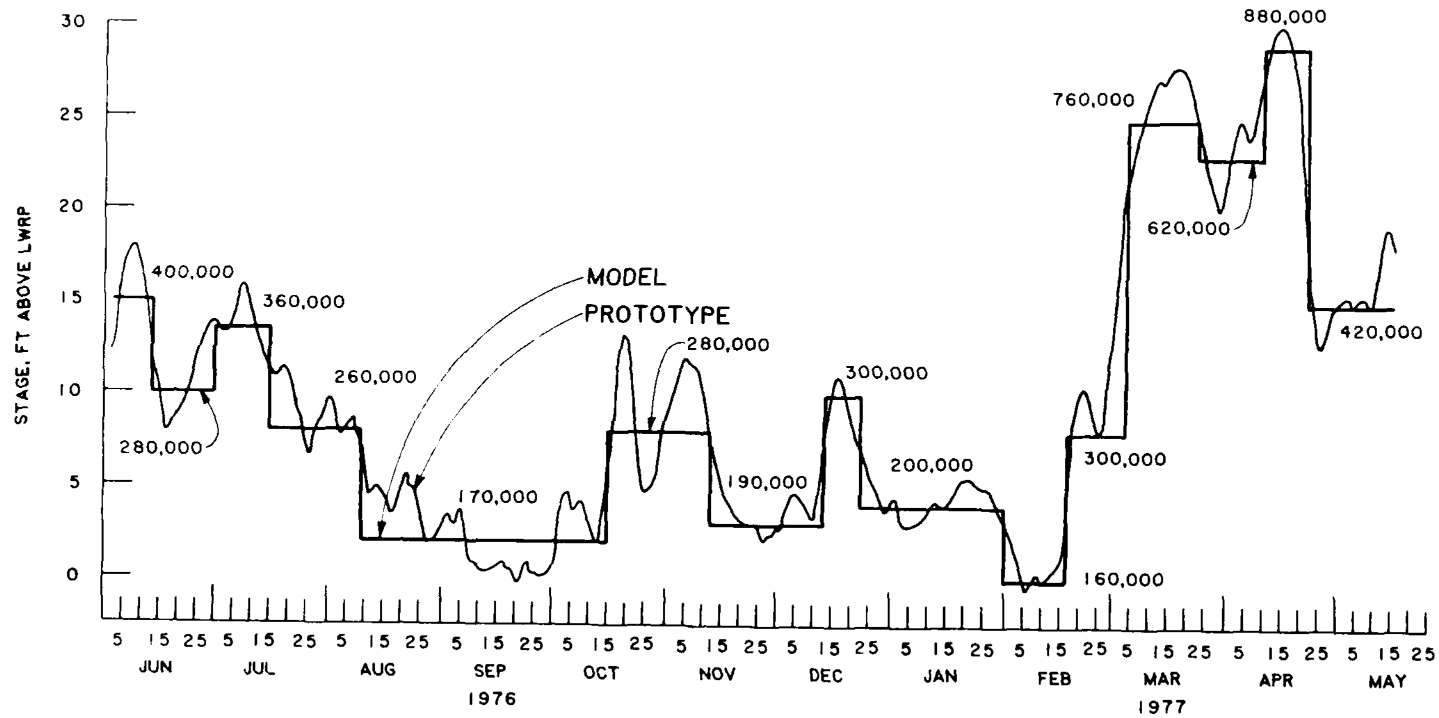
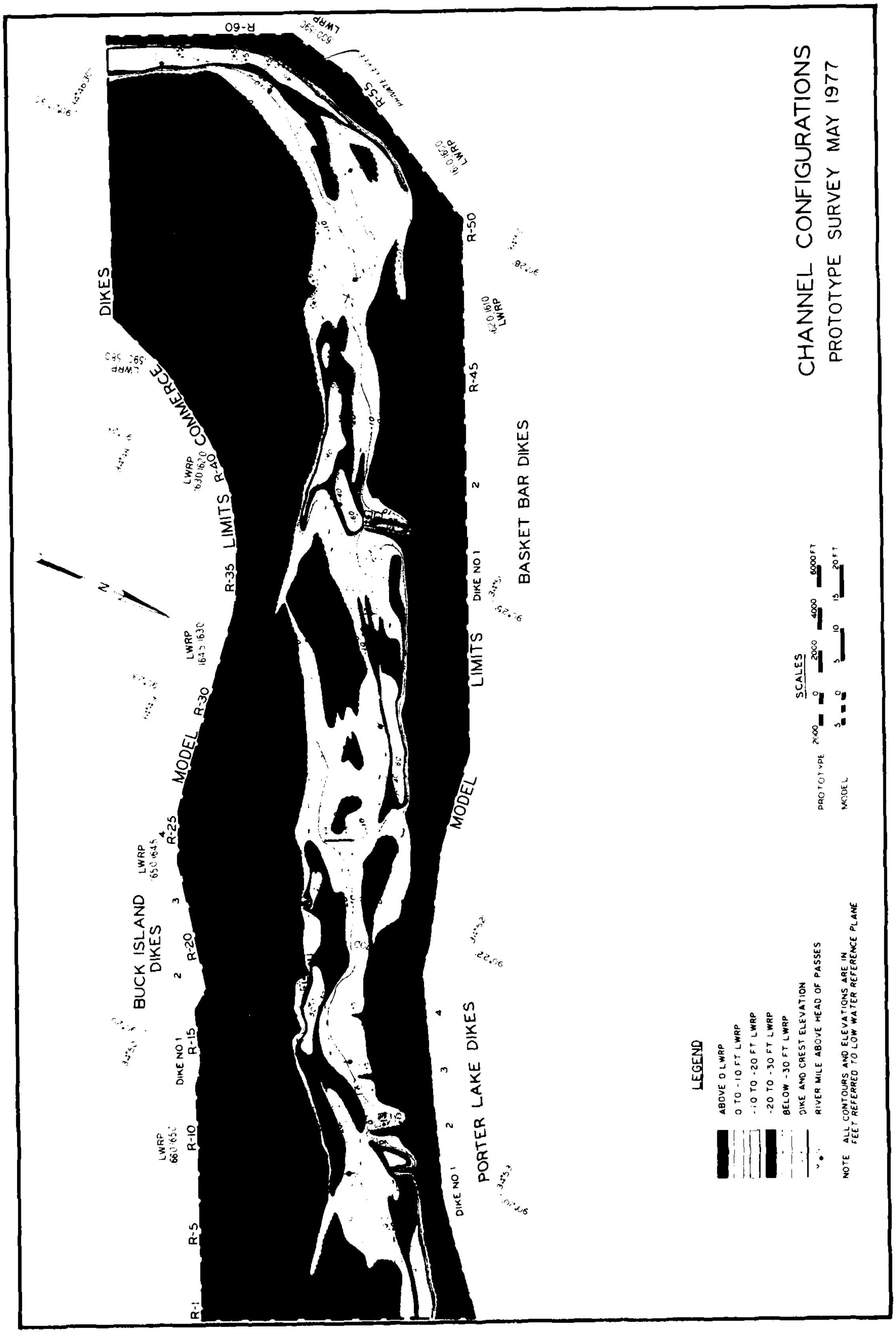
* Elevations (el) cited herein are in feet referenced to the Low Water Reference Plane (LWRP).



NOTE VALUES SHOWN ON HYDROGRAPH
ARE PROTOTYPE DISCHARGE IN CFS

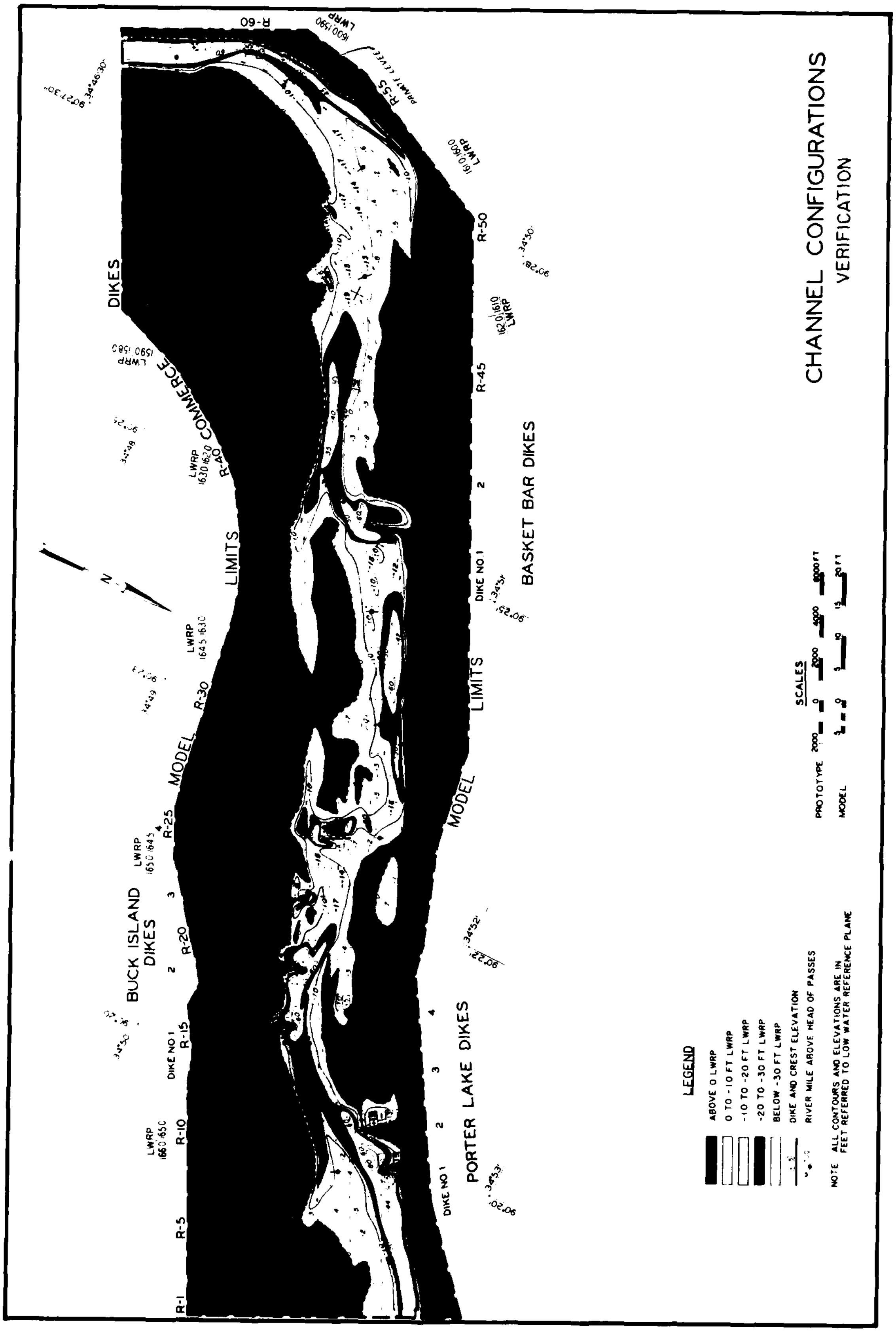
VERIFICATION HYDROGRAPH

PLATE 2



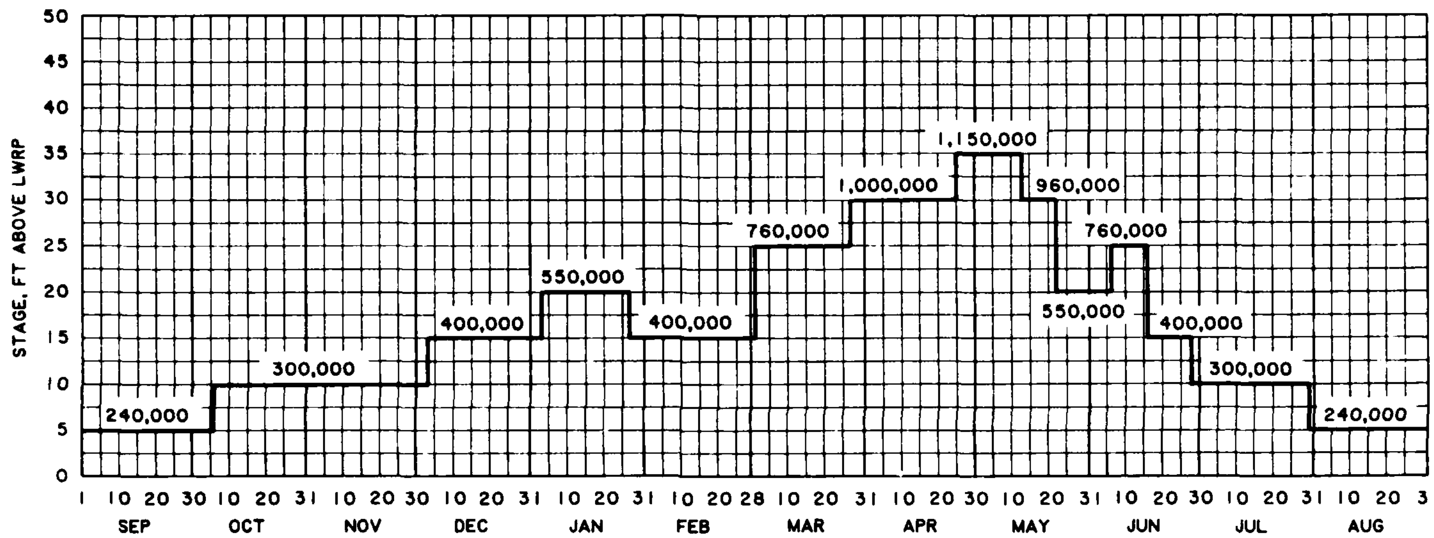
CHANNEL CONFIGURATIONS
PROTOTYPE SURVEY MAY 1977
MODEL LIMITS
COMMERCE DIKES
BUCK ISLAND DIKES
PORTER LAKE DIKES
BASKET BAR DIKES
DIKE NO 1
R-1
R-5
R-10
R-15
R-20
R-25
R-30
R-35
R-40
R-45
R-50
R-55
R-60
LWRP
N
LEGEND
ABOVE 0 LWRP
0 TO -10 FT LWRP
-10 TO -20 FT LWRP
-20 TO -30 FT LWRP
BELOW -30 FT LWRP
DIKE AND CREST ELEVATION
RIVER MILE ABOVE HEAD OF PASSES
NOTE ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO LOW WATER REFERENCE PLANE
SCALES
PROTOTYPE
MODEL

PLATE 3



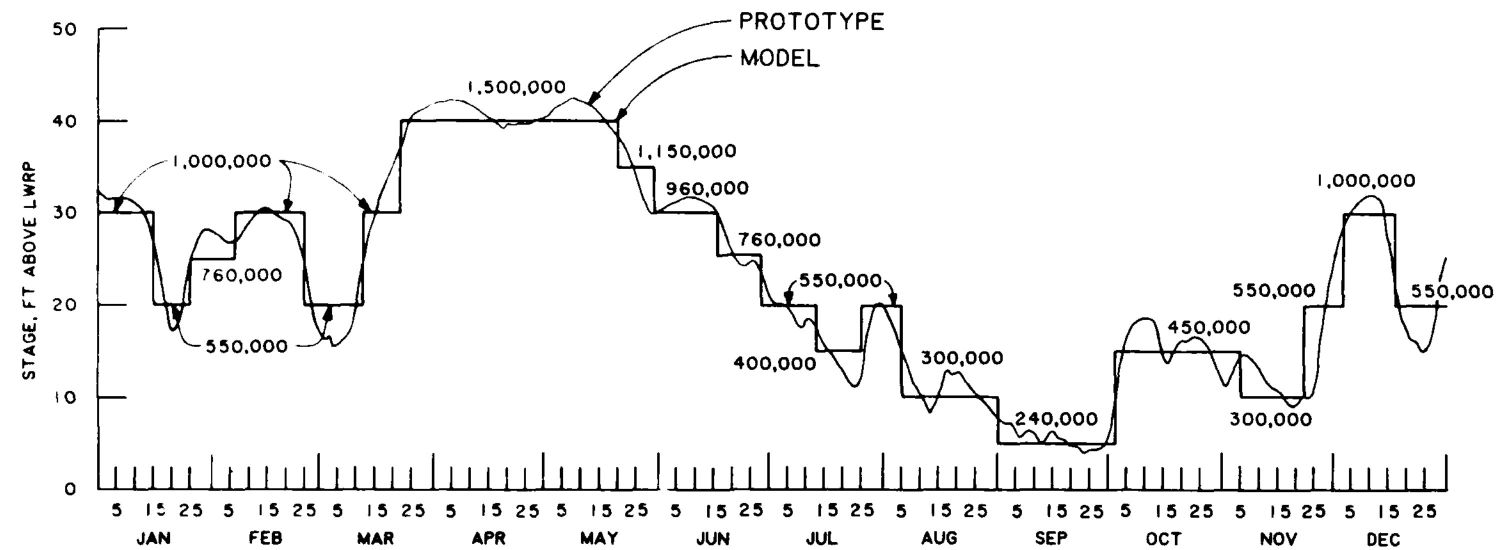
CHANNEL CONFIGURATIONS
VERIFICATION
COMMERCE DIKES
BUCK ISLAND DIKES
PORTER LAKE DIKES
BASKET BAR DIKES
MODEL LIMITS
MODEL LIMITS
DIKE NO 1
DIKE NO 1
DIKE NO 1
PRIVATE LEVEE
R-1
R-5
R-10
R-15
R-20
R-25
R-30
R-40
R-45
R-50
R-55
R-60
LEGEND
ABOVE 0 LWRP
0 TO -10 FT LWRP
-10 TO -20 FT LWRP
-20 TO -30 FT LWRP
BELOW -30 FT LWRP
DIKE AND CREST ELEVATION
RIVER MILE ABOVE HEAD OF PASSES
NOTE ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO LOW WATER REFERENCE PLANE
SCALES
PROTOTYPE
MODEL

PLATE 4



NOTE: VALUES SHOWN ON HYDROGRAPH
ARE PROTOTYPE DISCHARGE IN CFS

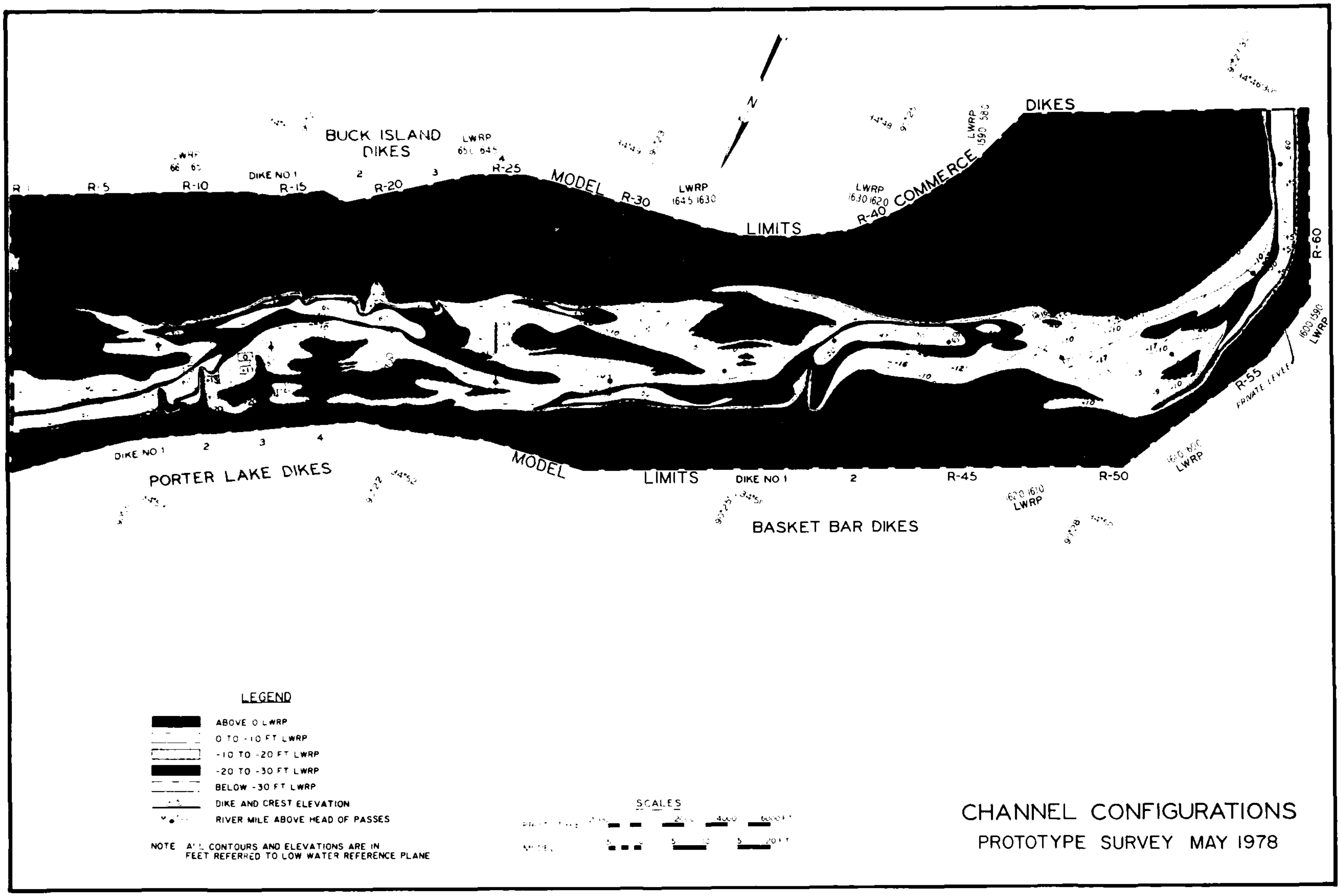
AVERAGE ANNUAL HYDROGRAPH



NOTE: VALUES SHOWN ON HYDROGRAPH
ARE PROTOTYPE DISCHARGE IN CFS

FLOOD HYDROGRAPH - 1973 PROTOTYPE

PLATE 6



CHANNEL CONFIGURATIONS
PROTOTYPE SURVEY MAY 1978

PLATE 7

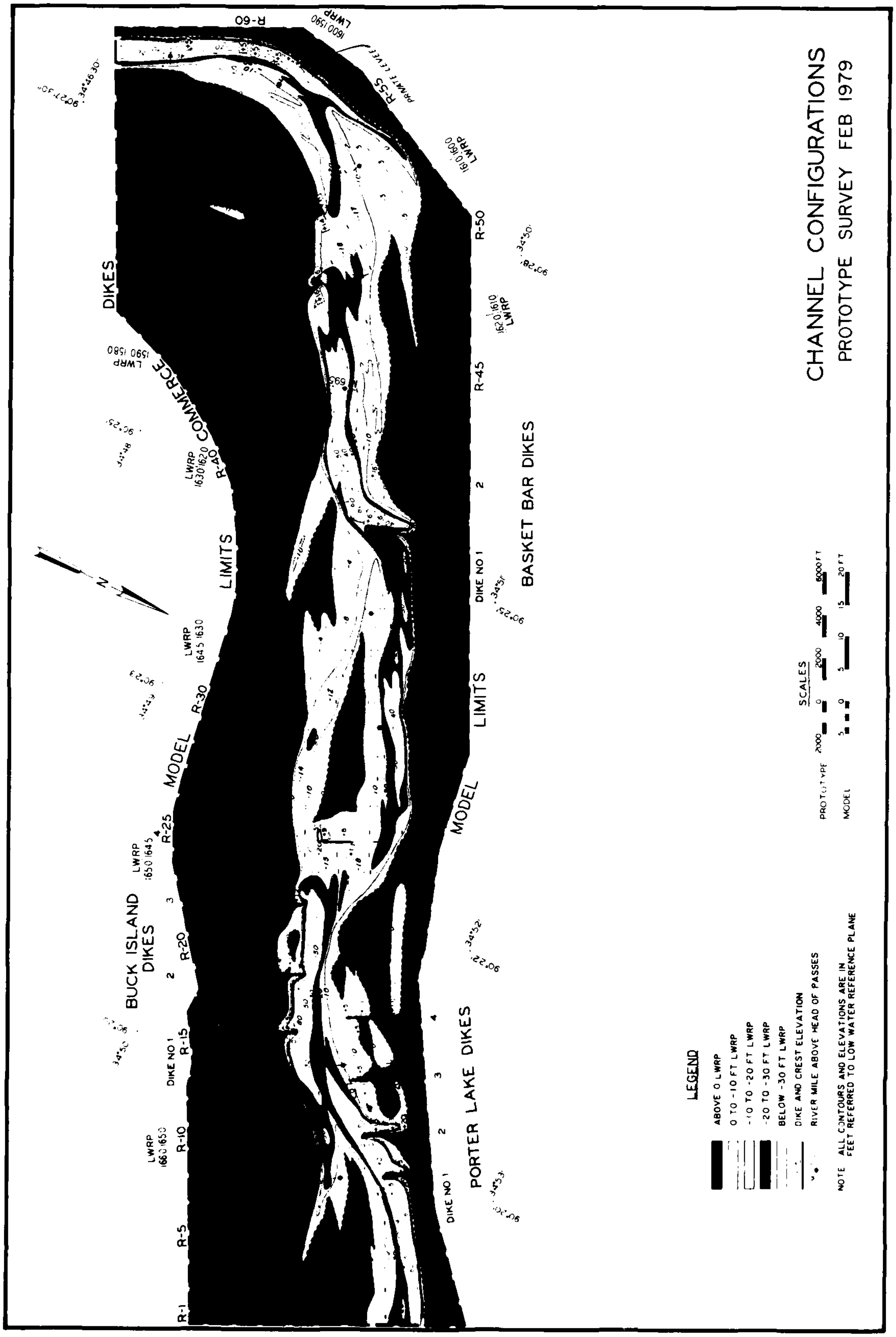
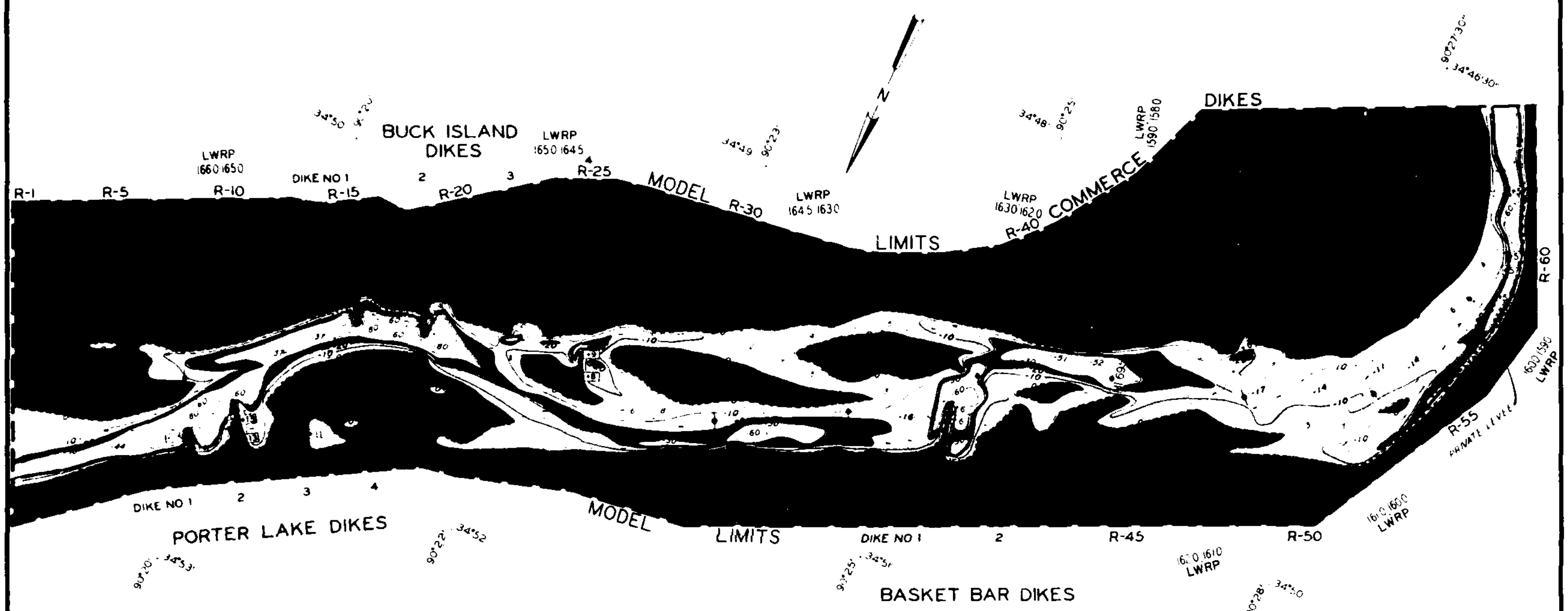

CHANNEL CONFIGURATIONS
PROTOTYPE SURVEY FEB 1979
BUCK ISLAND DIKES
PORTER LAKE DIKES
BASKET BAR DIKES
COMMERCE DIKES
MODEL LIMITS
DIKE NO 1
PRIVATE LEVEE
LWRP 1660 1650
LWRP 1650 1645
LWRP 1645 1630
LWRP 1630 1620
LWRP 1590 1580
LWRP 1620 1610
LWRP 1610 1600
LWRP 1600 1590
R-1
R-5
R-10
R-15
R-20
R-25
R-30
R-40
R-45
R-50
R-55
R-60
N
SCALES
PROTOTYPE 2000 0 2000 4000 6000 FT
MODEL 5 0 5 10 15 20 FT
LEGEND
ABOVE 0 LWRP
0 TO -10 FT LWRP
-10 TO -20 FT LWRP
-20 TO -30 FT LWRP
BELOW -30 FT LWRP
DIKE AND CREST ELEVATION
RIVER MILE ABOVE HEAD OF PASSES
NOTE ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO LOW WATER REFERENCE PLANE

PLATE 8



LEGEND

- ABOVE 0 LWRP
- 0 TO -10 FT LWRP
- -10 TO -20 FT LWRP
- -20 TO -30 FT LWRP
- BELOW -30 FT LWRP
- DIKE AND CREST ELEVATION
- RIVER MILE ABOVE HEAD OF PASSES

NOTE ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO LOW WATER REFERENCE PLANE

SCALES

CHANNEL CONFIGURATIONS
BASE TEST RUN 4

PLATE 9

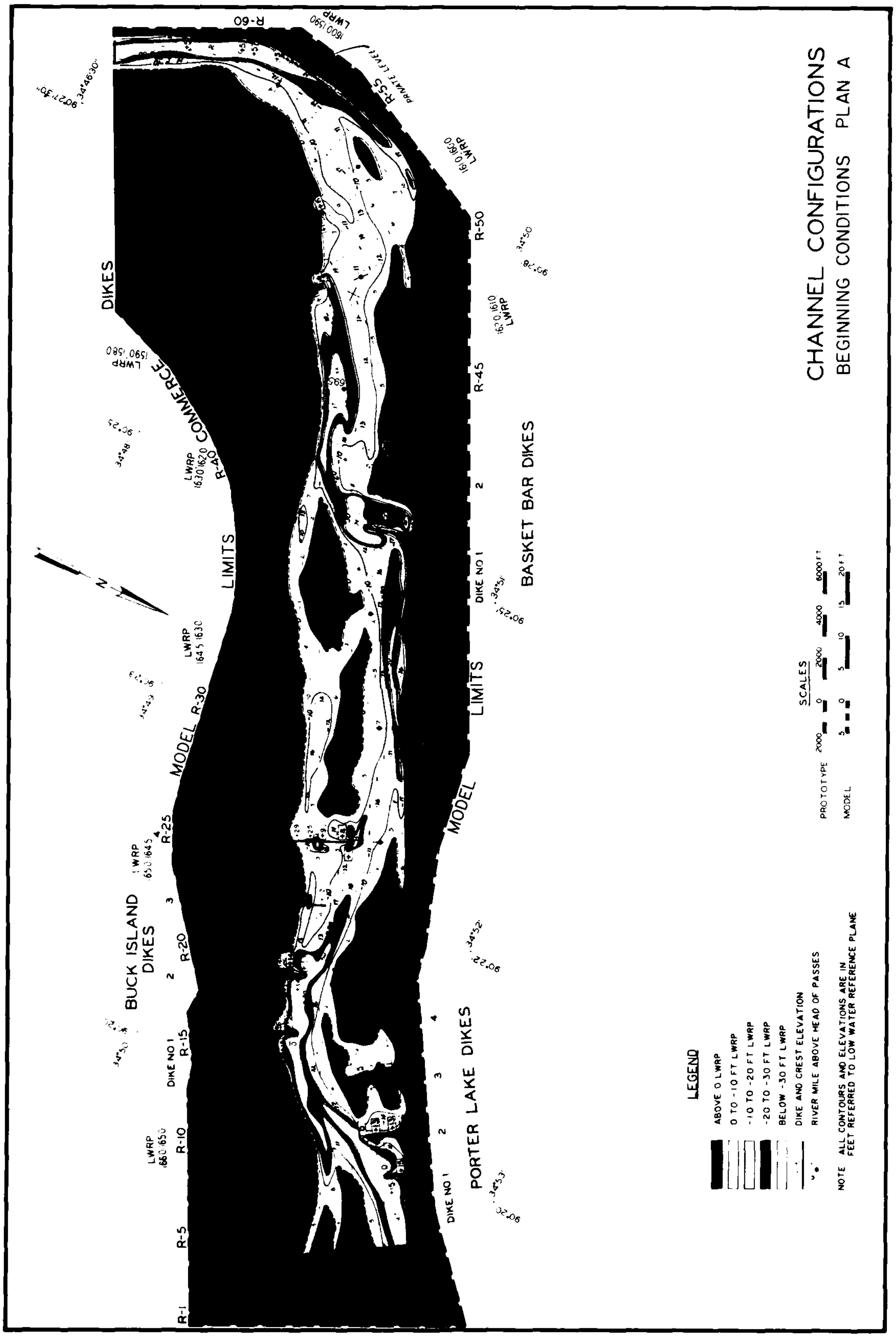
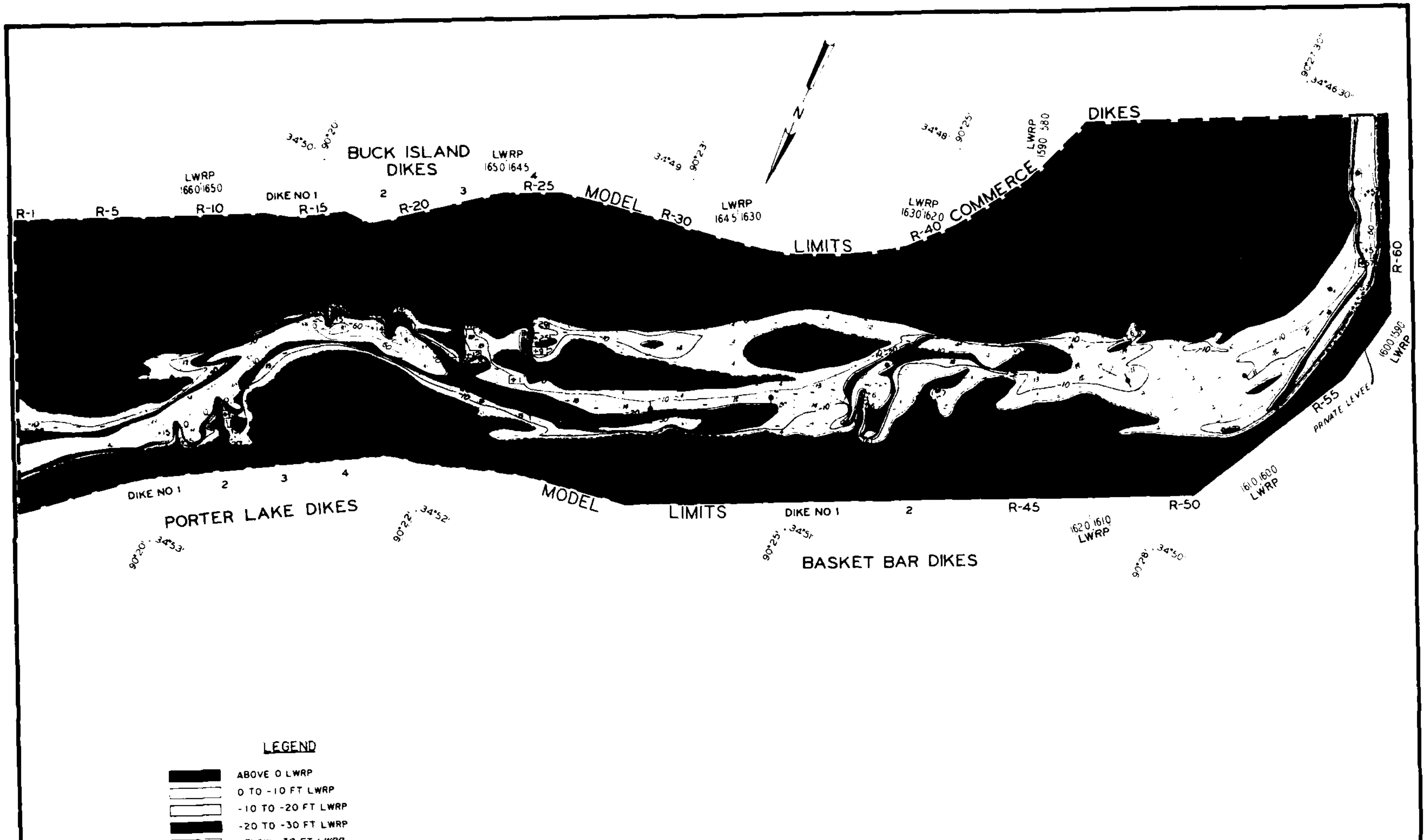

CHANNEL CONFIGURATIONS
BEGINNING CONDITIONS PLAN A
LEGEND
ABOVE 0 LWRP
0 TO -10 FT LWRP
-10 TO -20 FT LWRP
-20 TO -30 FT LWRP
BELOW -30 FT LWRP
DIKE AND CREST ELEVATION
RIVER MILE ABOVE HEAD OF PASSES
NOTE ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO LOW WATER REFERENCE PLANE
SCALES
PROTOTYPE 2000 0 2000 4000 6000 FT
MODEL 5 0 5 10 15 20 FT
MODEL LIMITS
COMMERCE DIKES
BASKET BAR DIKES
BUCK ISLAND DIKES
PORTER LAKE DIKES
DIKE NO 1
PRIVATE LEVEE
LWRP
N
R-1
R-5
R-10
R-15
R-20
R-25
R-30
R-40
R-45
R-50
R-55
R-60

PLATE 10



CHANNEL CONFIGURATIONS
PLAN A RUN 2

PLATE 11

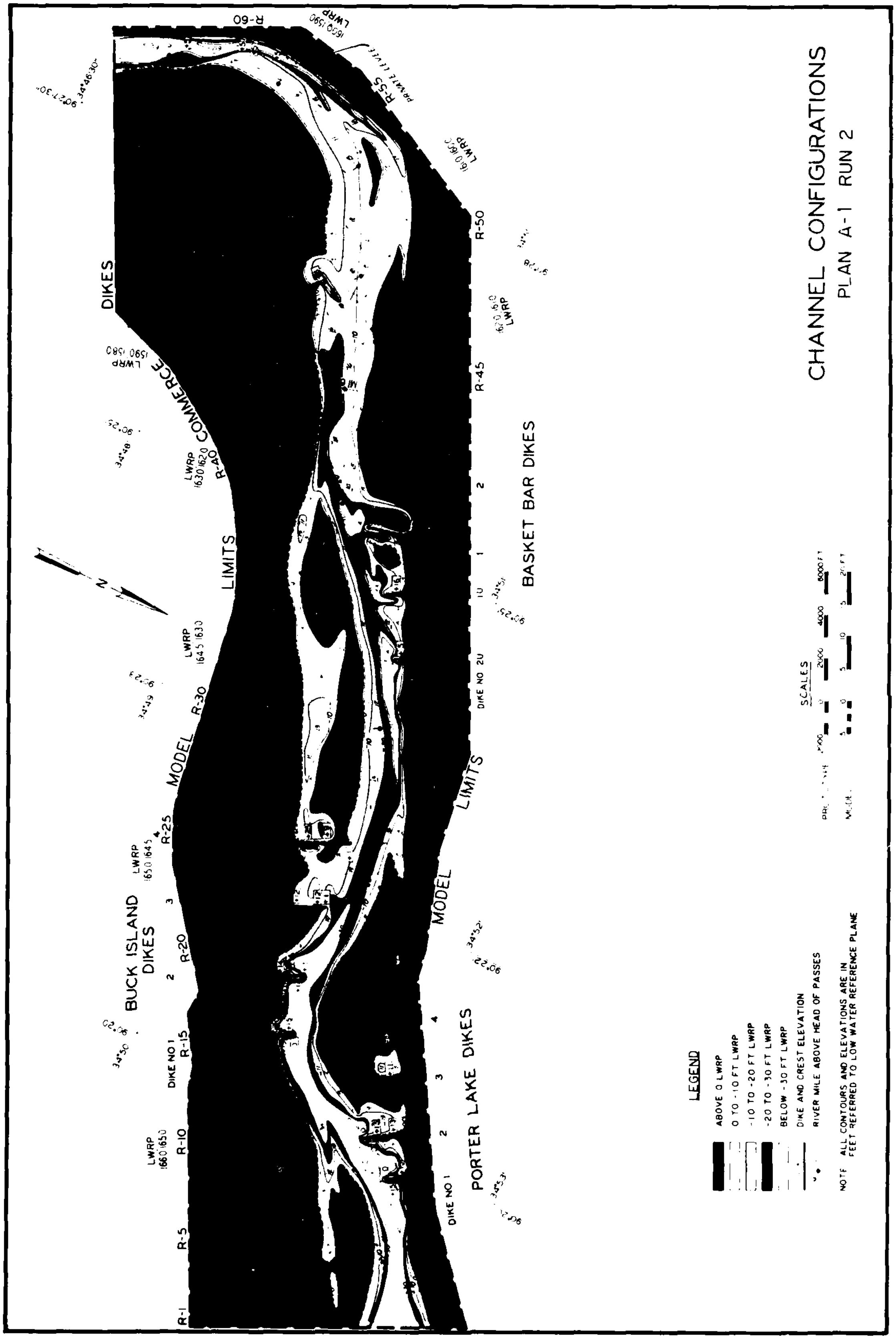

CHANNEL CONFIGURATIONS
PLAN A-1 RUN 2
LEGEND
ABOVE 0 LWRP
0 TO -10 FT LWRP
-10 TO -20 FT LWRP
-20 TO -30 FT LWRP
BELOW -30 FT LWRP
DIKE AND CREST ELEVATION
RIVER MILE ABOVE HEAD OF PASSES
NOTE ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO LOW WATER REFERENCE PLANE
SCALES
MODEL LIMITS
COMMERCE DIKES
BUCK ISLAND DIKES
BASKET BAR DIKES
PORTER LAKE DIKES
DIKE NO 1
DIKE NO 20
PRIVATE LEVEE
R-1
R-5
R-10
R-15
R-20
R-25
R-30
R-40
R-45
R-50
R-55
R-60
LWRP

PLATE 12

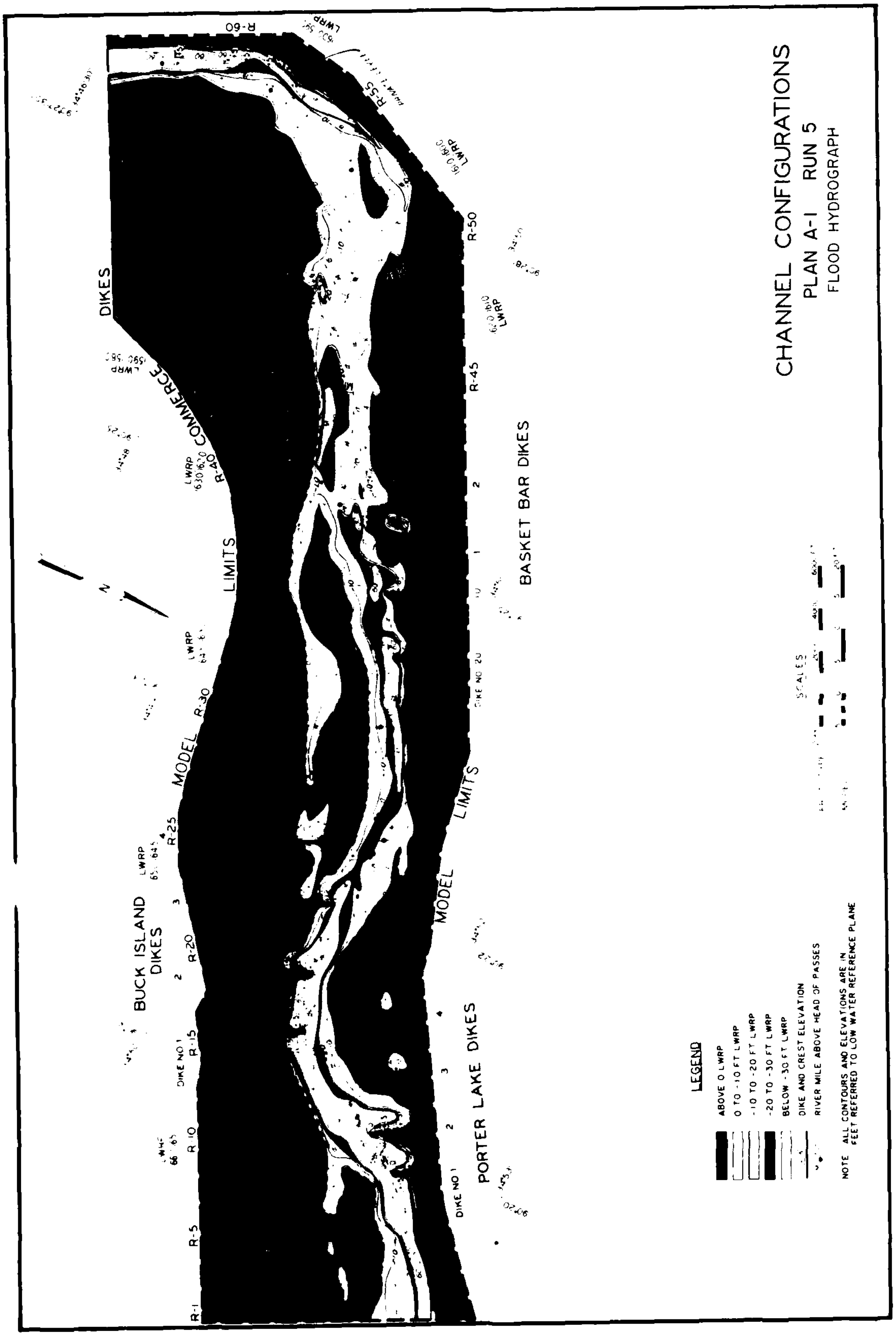
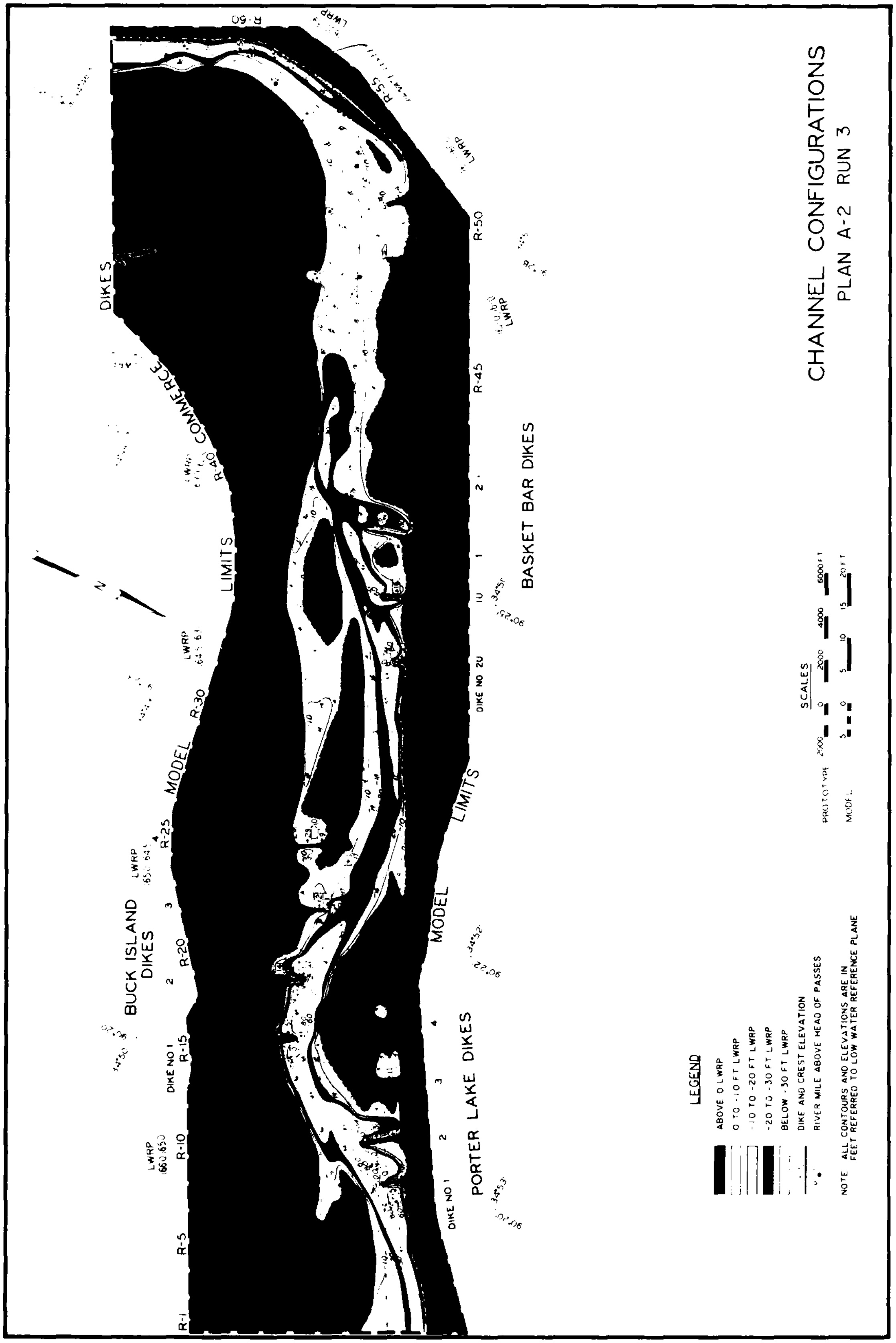
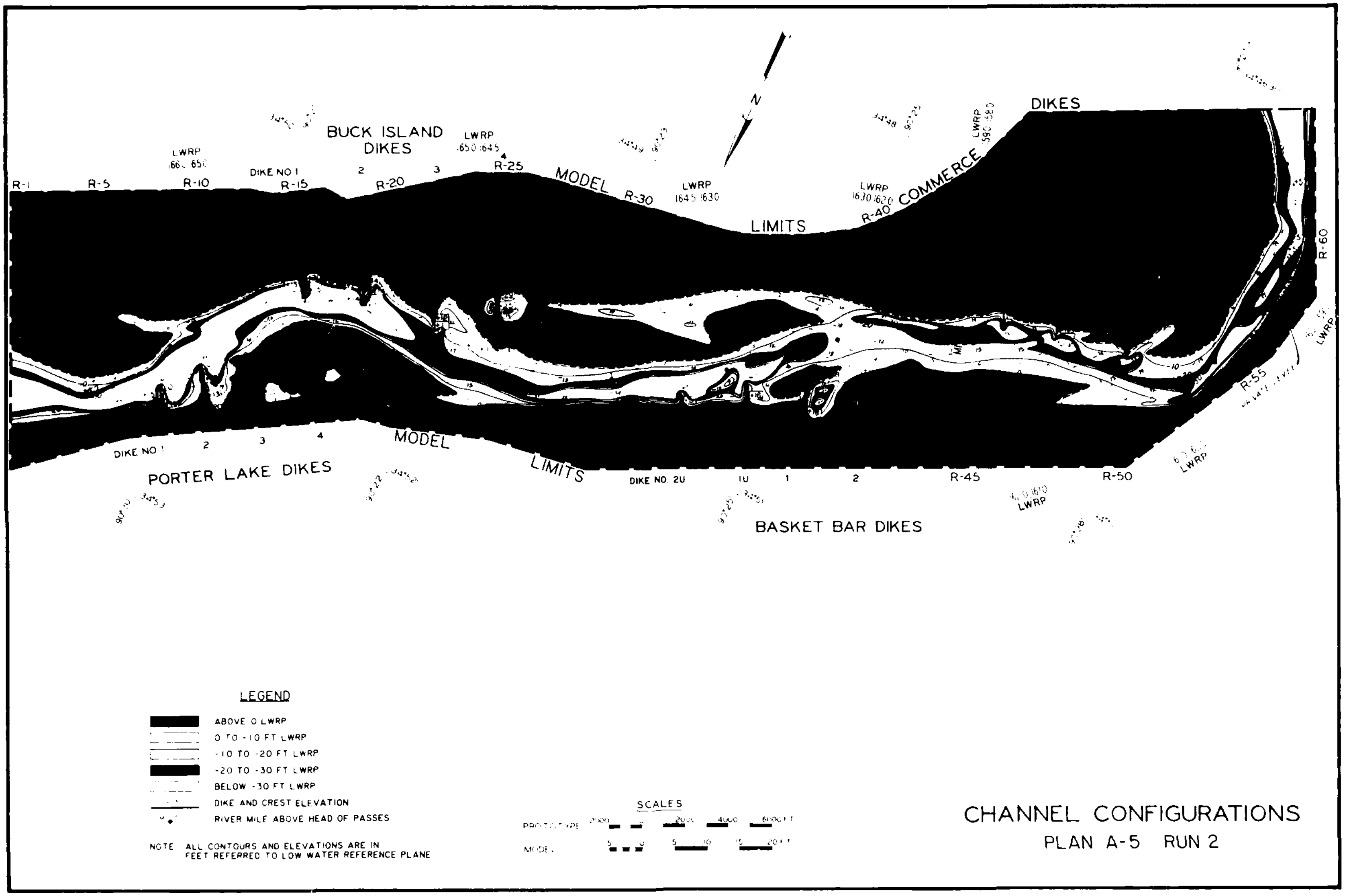

CHANNEL CONFIGURATIONS
PLAN A-1 RUN 5
FLOOD HYDROGRAPH
LEGEND
ABOVE 0 LWRP
0 TO -10 FT LWRP
-10 TO -20 FT LWRP
-20 TO -30 FT LWRP
BELOW -30 FT LWRP
DIKE AND CREST ELEVATION
RIVER MILE ABOVE HEAD OF PASSES
NOTE ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO LOW WATER REFERENCE PLANE
SCALES
BUCK ISLAND DIKES
PORTER LAKE DIKES
BASKET BAR DIKES
DIKES
MODEL LIMITS
COMMERCE
DIKE NO 1
DIKE NO 20
R-1
R-5
R-10
R-15
R-20
R-25
R-30
R-40
R-45
R-50
R-55
R-60
LWRP

PLATE 13



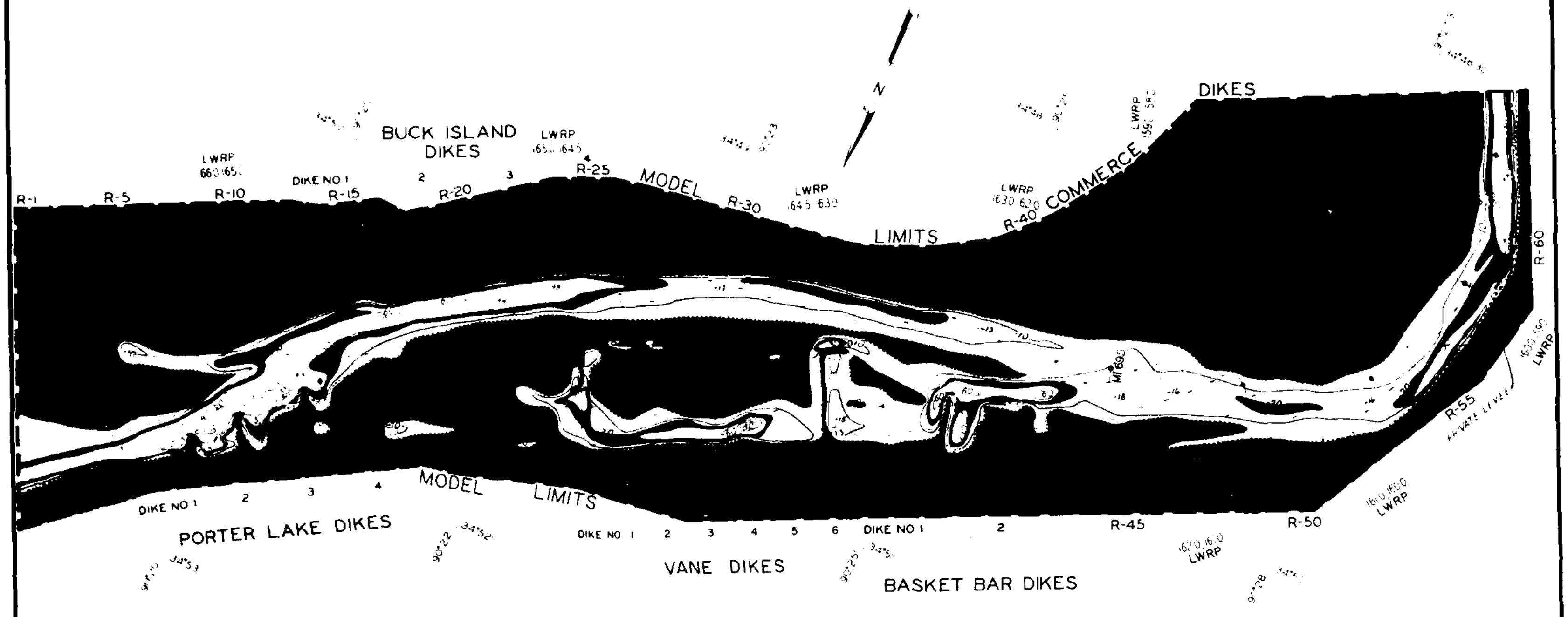
CHANNEL CONFIGURATIONS
PLAN A-2 RUN 3

PLATE 14



CHANNEL CONFIGURATIONS
PLAN A-5 RUN 2

PLATE 15



LEGEND

ABOVE 0 LWRP
0 TO -10 FT LWRP
-10 TO -20 FT LWRP
-20 TO -30 FT LWRP
BELOW -30 FT LWRP
DIKE AND CREST ELEVATION
RIVER MILE ABOVE HEAD OF PASSES

NOTE ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO LOW WATER REFERENCE PLANE

SCALES

PROTOTYPE 2000 0 2000 4000 6000 FT
MODEL 5 0 5 10 15 20 FT

CHANNEL CONFIGURATIONS
PLAN E-1 RUN 7
FLOOD HYDROGRAPH

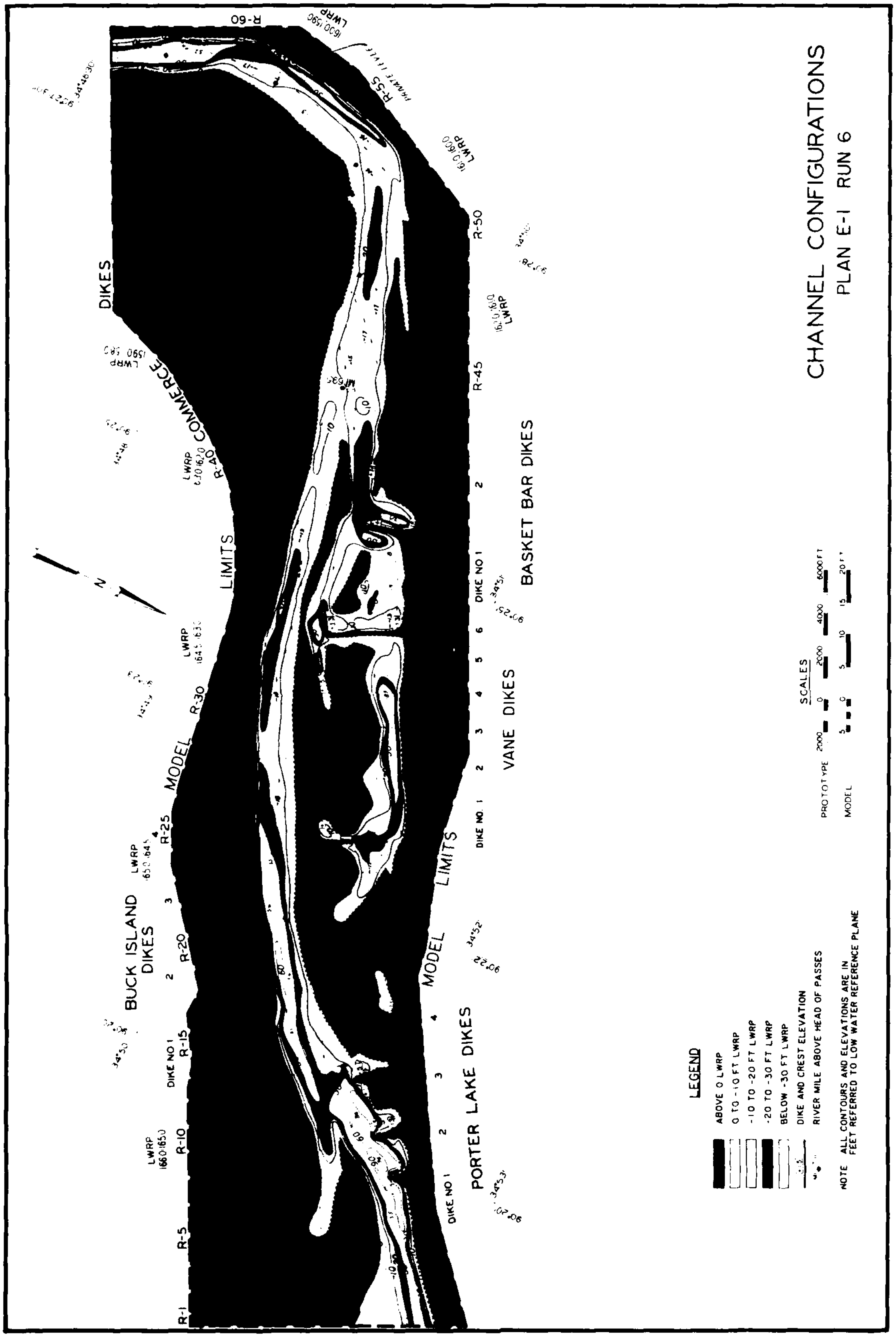

CHANNEL CONFIGURATIONS
PLAN E-1 RUN 6
LEGEND
ABOVE 0 LWRP
0 TO -10 FT LWRP
-10 TO -20 FT LWRP
-20 TO -30 FT LWRP
BELOW -30 FT LWRP
DIKE AND CREST ELEVATION
RIVER MILE ABOVE HEAD OF PASSES
NOTE ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO LOW WATER REFERENCE PLANE
SCALES
PROTOTYPE 2000 0 2000 4000 6000 FT
MODEL 5 0 5 10 15 20 FT
PORTER LAKE DIKES
BUCK ISLAND DIKES
VANE DIKES
BASKET BAR DIKES
COMMERCE DIKES
MODEL LIMITS
DIKE NO 1
N
R-1
R-5
R-10
R-15
R-20
R-25
R-30
R-40
R-45
R-50
R-55
R-60
LWRP

PLATE 28

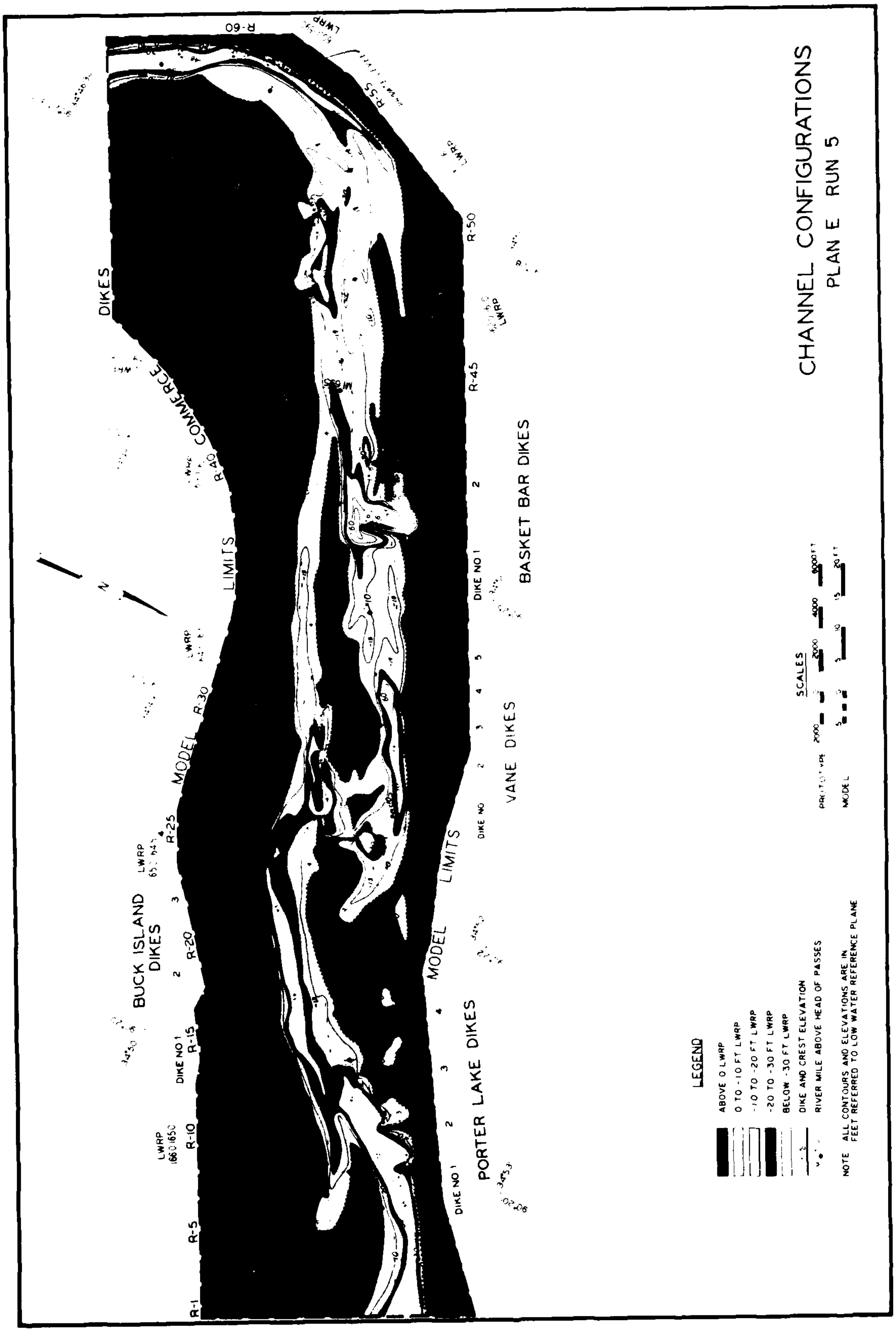
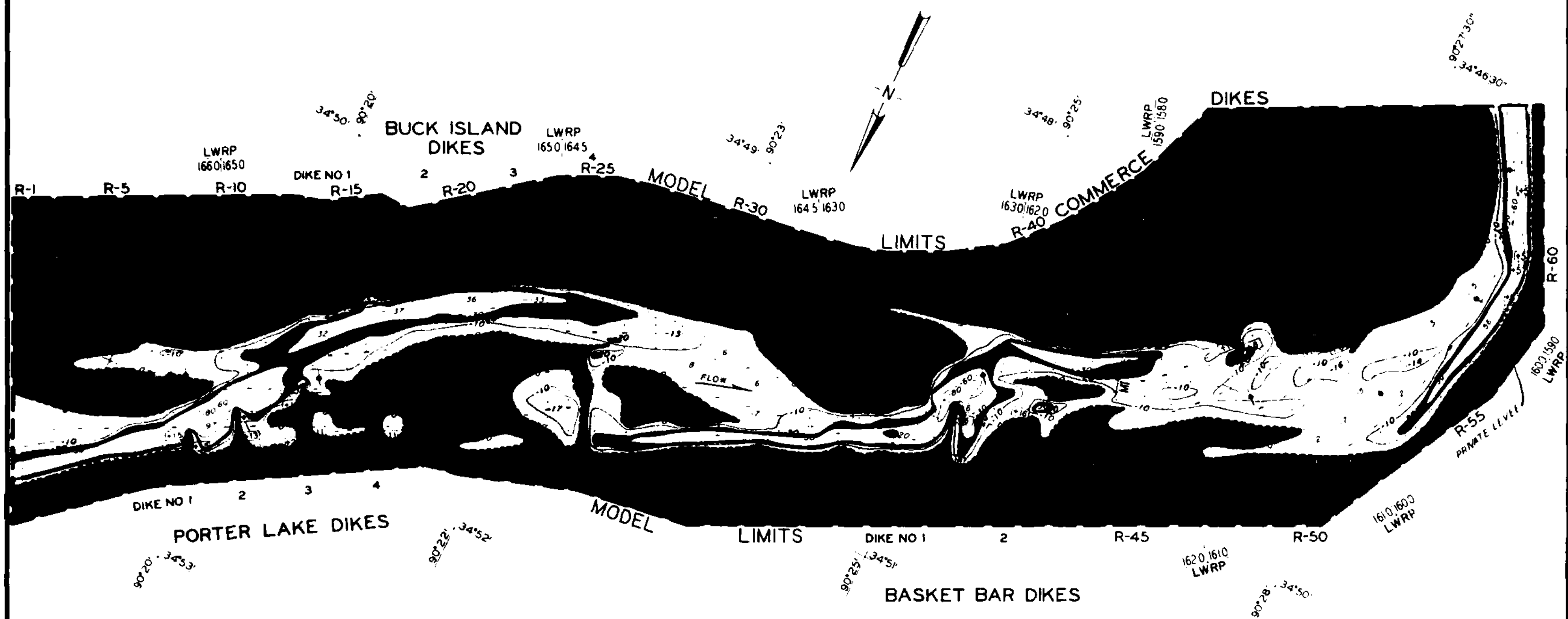

CHANNEL CONFIGURATIONS
PLAN E RUN 5
LEGEND
ABOVE 0 LWRP
0 TO -10 FT LWRP
-10 TO -20 FT LWRP
-20 TO -30 FT LWRP
BELOW -30 FT LWRP
DIKE AND CREST ELEVATION
RIVER MILE ABOVE HEAD OF PASSES
NOTE ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO LOW WATER REFERENCE PLANE
SCALES
PROTOTYPE
MODEL
BUCK ISLAND DIKES
PORTER LAKE DIKES
VANE DIKES
BASKET BAR DIKES
DIKES
MODEL LIMITS
COMMERCE
DIKE NO 1
R-1
R-5
R-10
R-15
R-20
R-25
R-30
R-40
R-45
R-50
R-55
R-60
LWRP

PLATE 27



LEGEND

- ABOVE 0 LWRP
- 0 TO -10 FT LWRP
- -10 TO -20 FT LWRP
- -20 TO -30 FT LWRP
- BELOW -30 FT LWRP
- DIKE AND CREST ELEVATION
- RIVER MILE ABOVE HEAD OF PASSES

NOTE ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO LOW WATER REFERENCE PLANE

SCALES

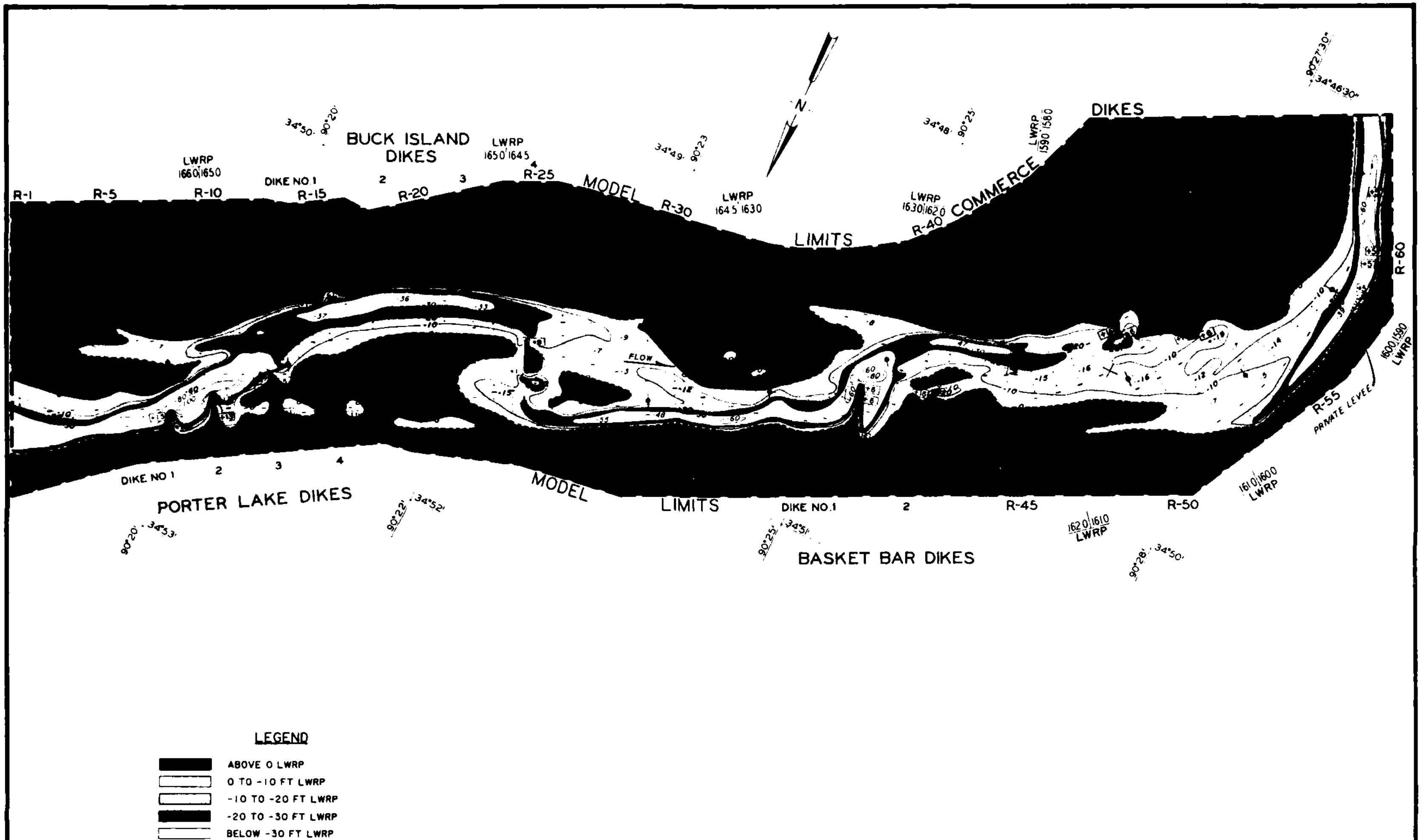
PROTOTYPE 2000 0 2000 4000 6000 FT

MODEL 5 0 5 10 15 20 FT

CHANNEL CONFIGURATIONS

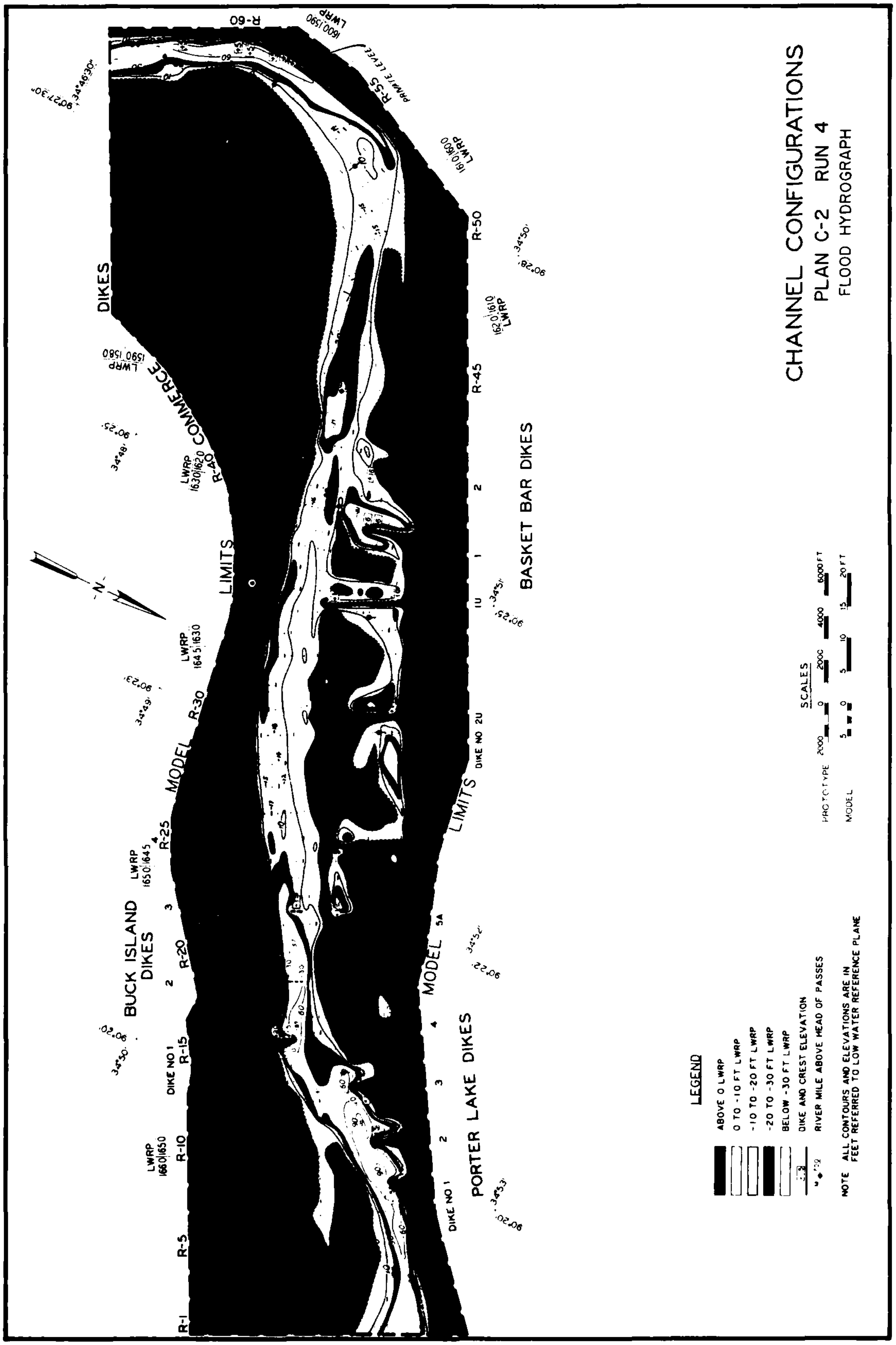
PLAN D-1 RUN 2

PLATE 26



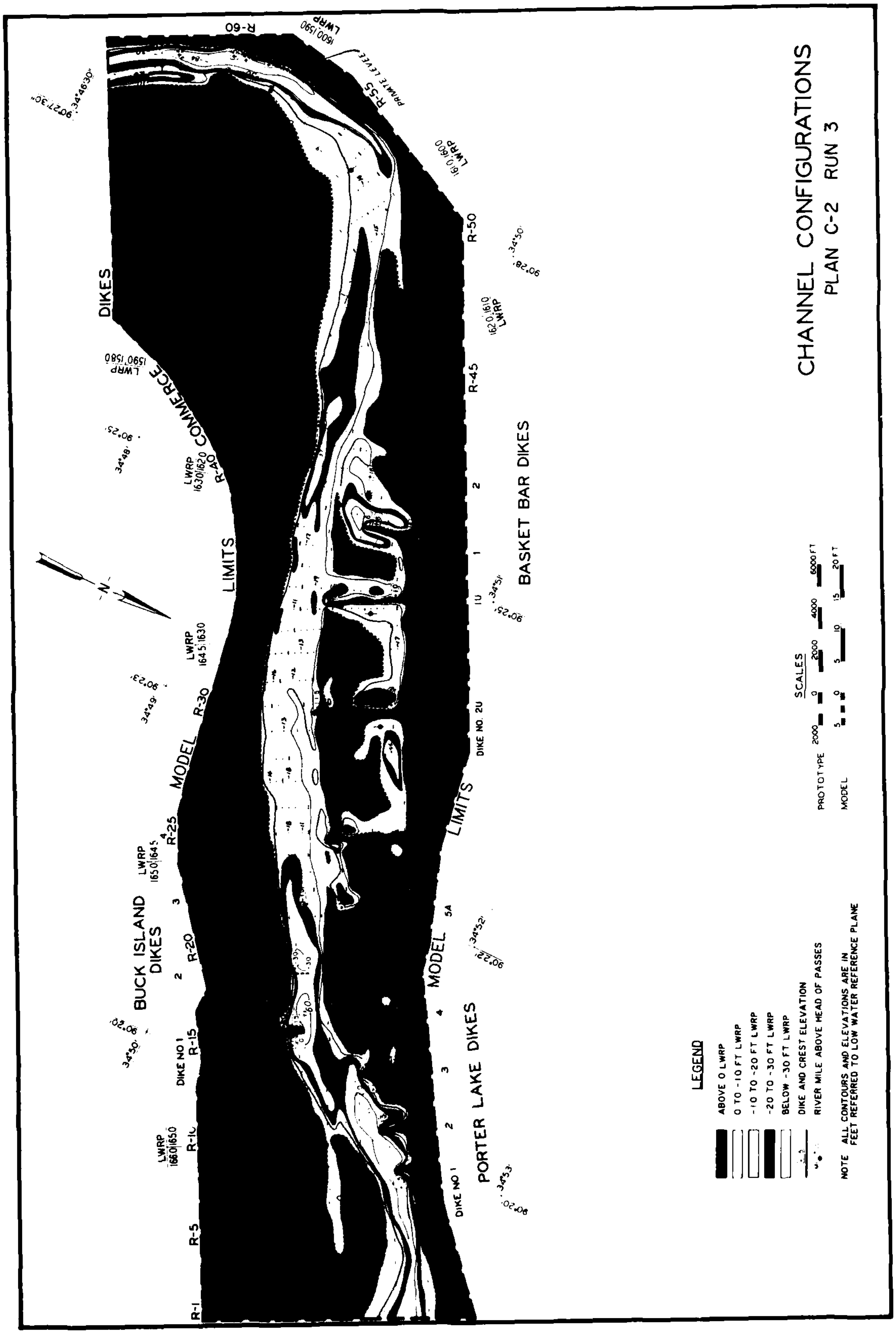
CHANNEL CONFIGURATIONS
PLAN D RUN 3

PLATE 25



CHANNEL CONFIGURATIONS
PLAN C-2 RUN 4
FLOOD HYDROGRAPH
LEGEND
ABOVE 0 LWRP
0 TO -10 FT LWRP
-10 TO -20 FT LWRP
-20 TO -30 FT LWRP
BELOW -30 FT LWRP
DIKE AND CREST ELEVATION
RIVER MILE ABOVE HEAD OF PASSES
NOTE ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO LOW WATER REFERENCE PLANE
SCALES
PROTOTYPE 2000 0 2000 4000 6000 FT
MODEL 5 0 5 10 15 20 FT
PORTER LAKE DIKES
BUCK ISLAND DIKES
BASKET BAR DIKES
COMMERCE DIKES
MODEL LIMITS
PRIVATE LEVEE
DIKE NO 1
DIKE NO 2U
LWRP
R-1
R-5
R-10
R-15
R-20
R-25
R-30
R-40
R-45
R-50
R-55
R-60

PLATE 24


CHANNEL CONFIGURATIONS
PLAN C-2 RUN 3
LEGEND
ABOVE 0 LWRP
0 TO -10 FT LWRP
-10 TO -20 FT LWRP
-20 TO -30 FT LWRP
BELOW -30 FT LWRP
DIKE AND CREST ELEVATION
RIVER MILE ABOVE HEAD OF PASSES
NOTE ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO LOW WATER REFERENCE PLANE
SCALES
PROTOTYPE 2000 0 2000 4000 6000 FT
MODEL 5 0 5 10 15 20 FT
BUCK ISLAND DIKES
PORTER LAKE DIKES
BASKET BAR DIKES
MODEL LIMITS
COMMERCE DIKES
PRIMITE LEVEE
DIKE NO 1
DIKE NO. 2U
N
R-1
R-5
R-10
R-15
R-20
R-25
R-30
R-40
R-45
R-50
R-55
R-60
LWRP 1660 1650
LWRP 1650 1645
LWRP 1645 1630
LWRP 1630 1620
LWRP 1590 1580
LWRP 1620 1610
LWRP 1610 1600
LWRP 1600 1590

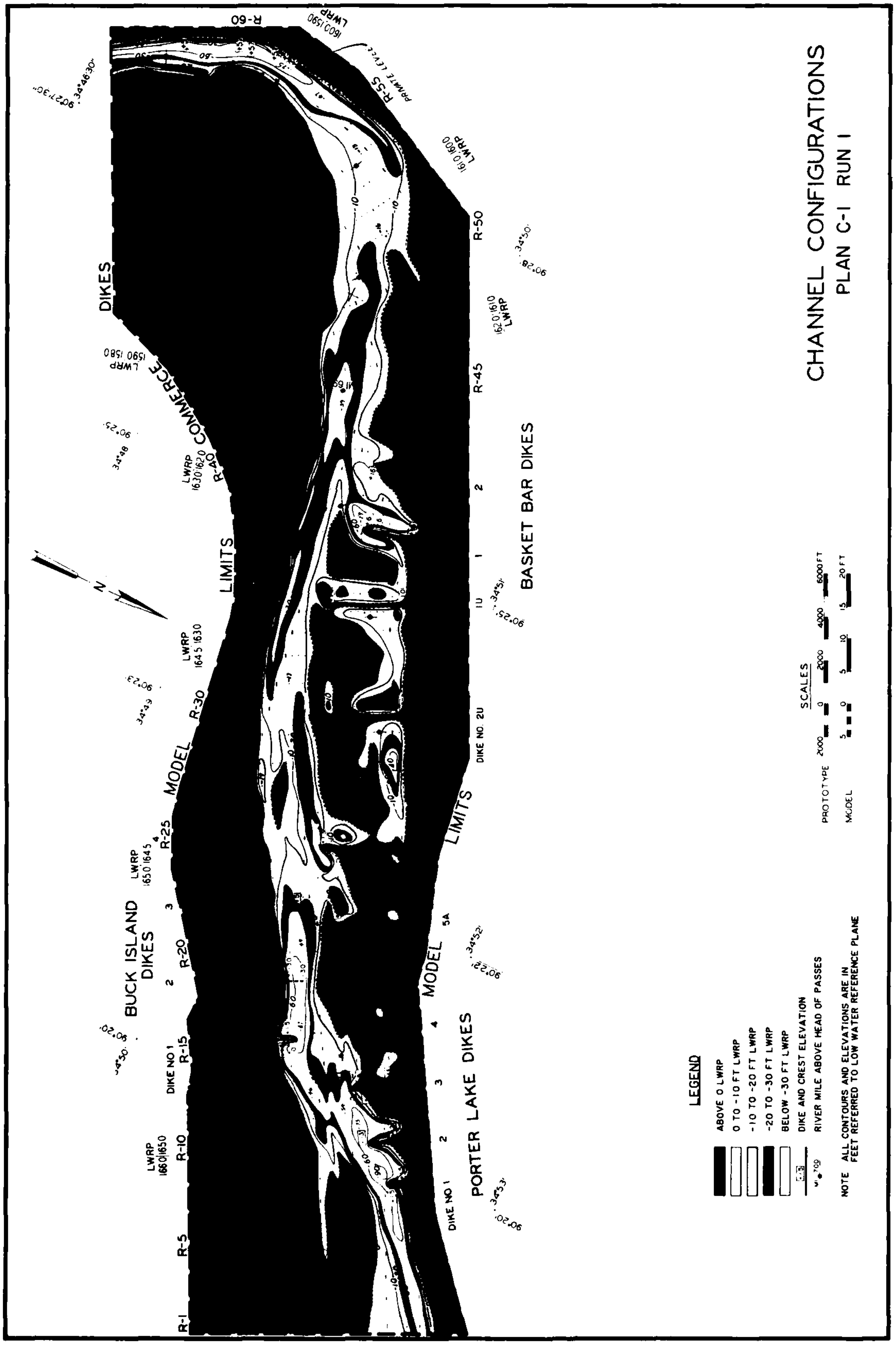
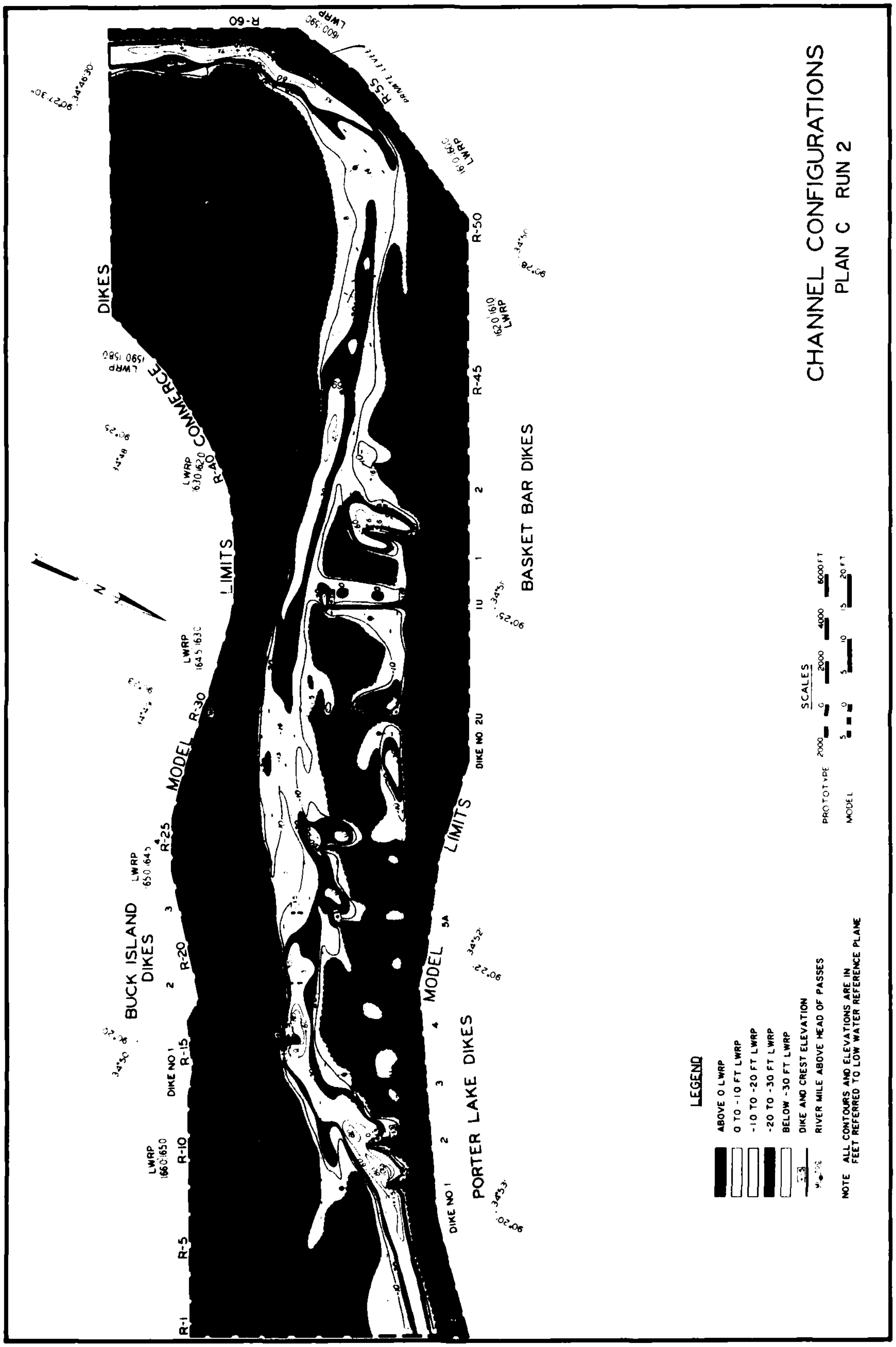
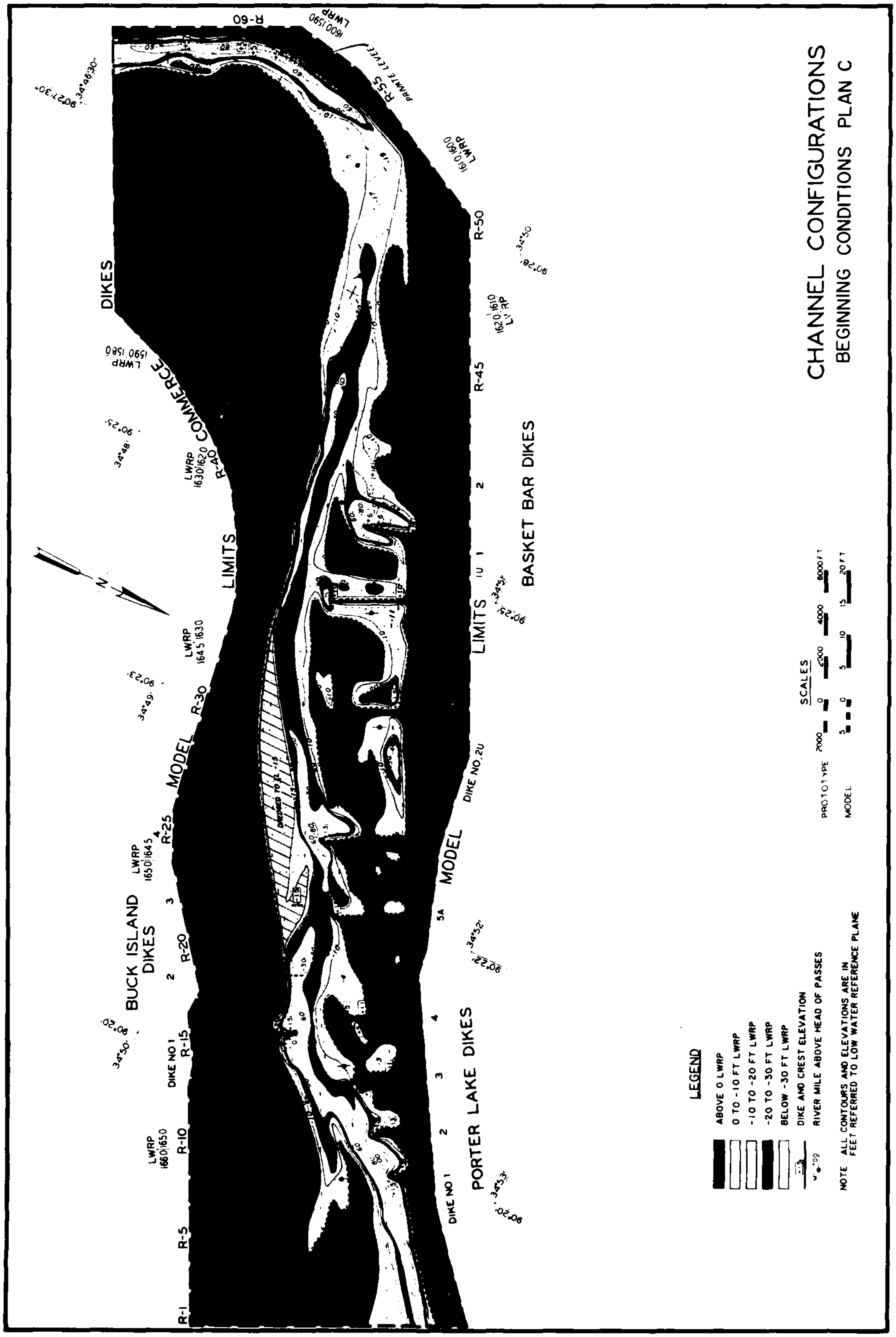

CHANNEL CONFIGURATIONS
PLAN C-1 RUN 1
LEGEND
ABOVE 0 LWRP
0 TO -10 FT LWRP
-10 TO -20 FT LWRP
-20 TO -30 FT LWRP
BELOW -30 FT LWRP
DIKE AND CREST ELEVATION
RIVER MILE ABOVE HEAD OF PASSES
NOTE ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO LOW WATER REFERENCE PLANE
SCALES
PROTOTYPE
MODEL
BUCK ISLAND DIKES
PORTER LAKE DIKES
BASKET BAR DIKES
COMMERCE DIKES
MODEL LIMITS
N

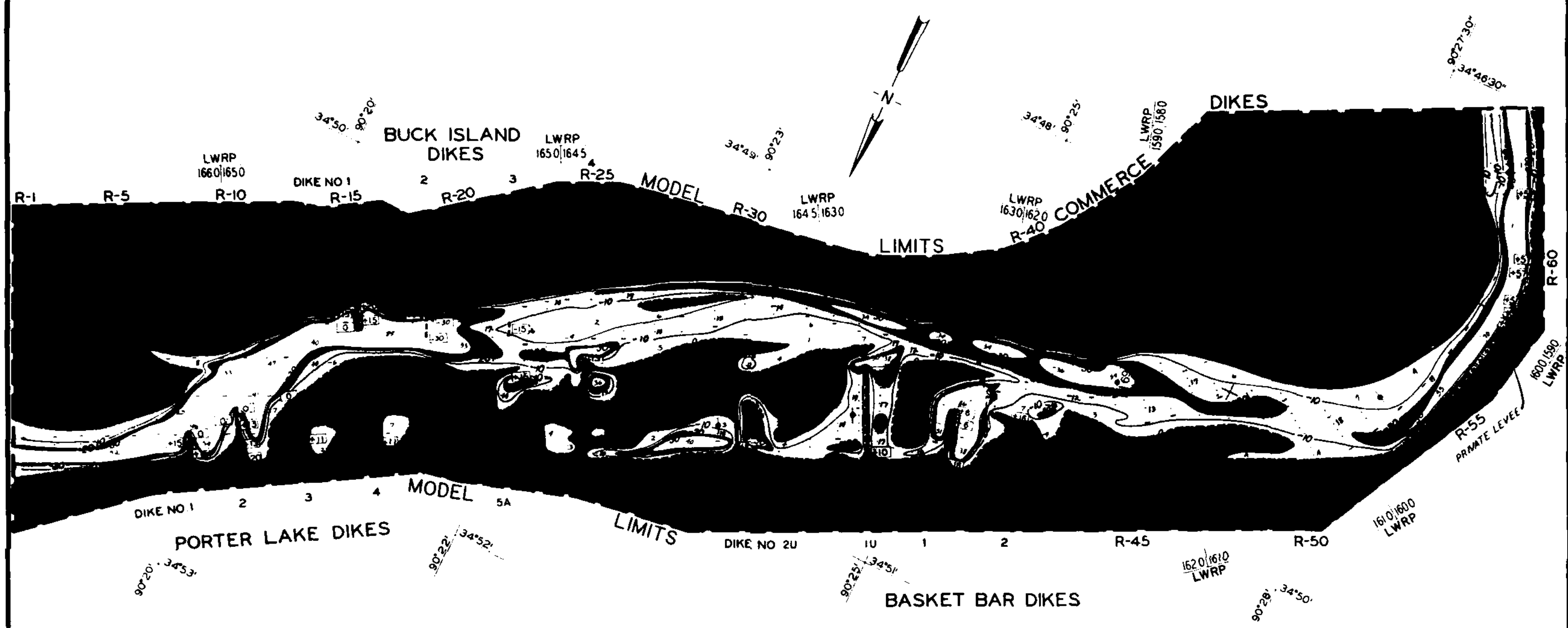
PLATE 22


CHANNEL CONFIGURATIONS
PLAN C RUN 2
LEGEND
ABOVE 0 LWRP
0 TO -10 FT LWRP
-10 TO -20 FT LWRP
-20 TO -30 FT LWRP
BELOW -30 FT LWRP
DIKE AND CREST ELEVATION
RIVER MILE ABOVE HEAD OF PASSES
NOTE ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO LOW WATER REFERENCE PLANE
SCALES
PROTOTYPE 2000 0 2000 4000 6000 FT
MODEL 5 0 5 10 15 20 FT
BUCK ISLAND DIKES
PORTER LAKE DIKES
BASKET BAR DIKES
DIKES
MODEL LIMITS
COMMERCE
DIKE NO 1
DIKE NO 2U
LWRP
R-1
R-5
R-10
R-15
R-20
R-25
R-30
R-40
R-45
R-50
R-55
R-60



CHANNEL CONFIGURATIONS
BEGINNING CONDITIONS PLAN C
LEGEND
ABOVE 0 LWRP
0 TO -10 FT LWRP
-10 TO -20 FT LWRP
-20 TO -30 FT LWRP
BELOW -30 FT LWRP
DIKE AND CREST ELEVATION
RIVER MILE ABOVE HEAD OF PASSES
NOTE ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO LOW WATER REFERENCE PLANE
SCALES
PROTOTYPE 2000 0 2000 4000 6000 FT
MODEL 5 0 5 10 15 20 FT
COMMERCE DIKES
MODEL LIMITS
BASKET BAR DIKES
BUCK ISLAND DIKES
PORTER LAKE DIKES
DIKE NO 1
DIKE NO 2U
PRIVATE LEVEE
DREDGED TO EL -15
N
R-1
R-5
R-10
R-15
R-20
R-25
R-30
R-40
R-45
R-50
R-55
R-60
LWRP

PLATE 20



LEGEND

- ABOVE 0 LWRP
- 0 TO -10 FT LWRP
- -10 TO -20 FT LWRP
- -20 TO -30 FT LWRP
- BELOW -30 FT LWRP
- DIKE AND CREST ELEVATION
- RIVER MILE ABOVE HEAD OF PASSES

NOTE ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO LOW WATER REFERENCE PLANE

SCALES

PROTOTYPE 2000 0 2000 4000 6000 FT

MODEL 5 0 5 10 15 20 FT

CHANNEL CONFIGURATIONS

PLAN B-7 RUN 3

FLOOD HYDROGRAPH

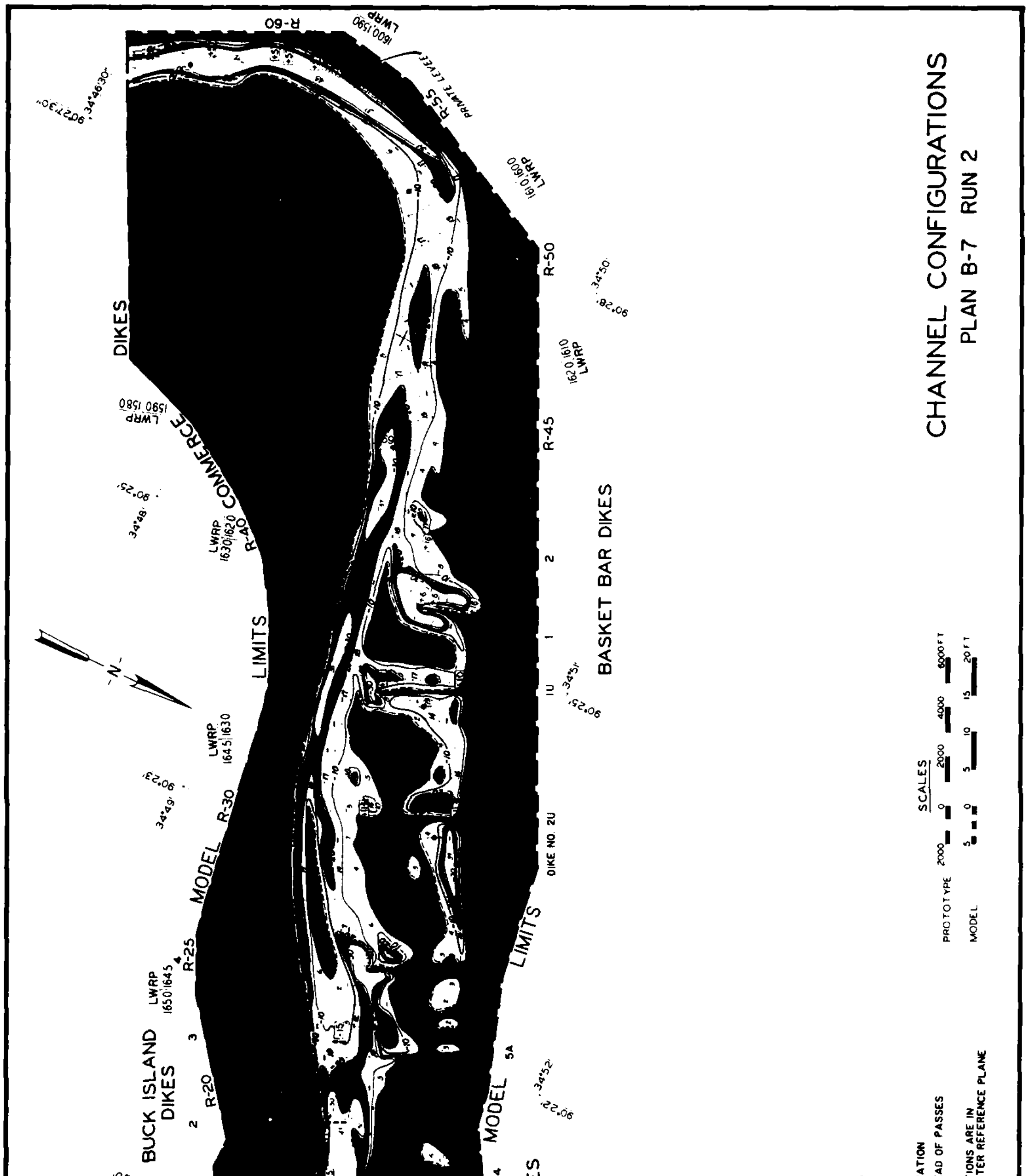
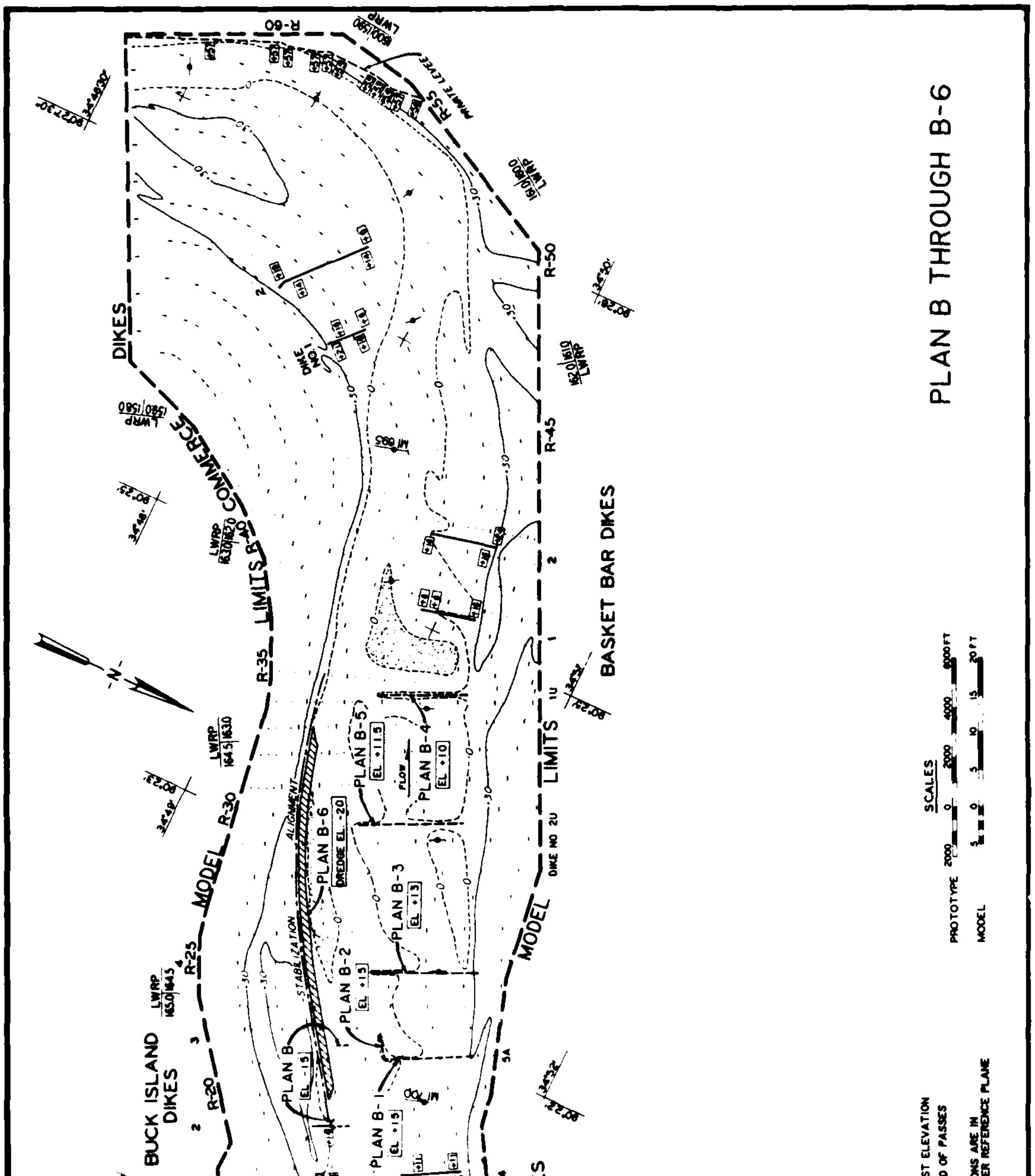

CHANNEL CONFIGURATIONS
PLAN B-7 RUN 2
COMMERCE DIKES
BUCK ISLAND DIKES
PORTER LAKE DIKES
BASKET BAR DIKES
MODEL LIMITS
MODEL LIMITS
PRIVATE LEVEE
N
LEGEND
ABOVE 0 LWRP
0 TO -10 FT LWRP
-10 TO -20 FT LWRP
-20 TO -30 FT LWRP
BELOW -30 FT LWRP
DIKE AND CREST ELEVATION
RIVER MILE ABOVE HEAD OF PASSES
NOTE ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO LOW WATER REFERENCE PLANE
SCALES
PROTOTYPE 2000 0 2000 4000 6000 FT
MODEL 5 0 5 10 15 20 FT

PLATE 18



PLAN B THROUGH B-6

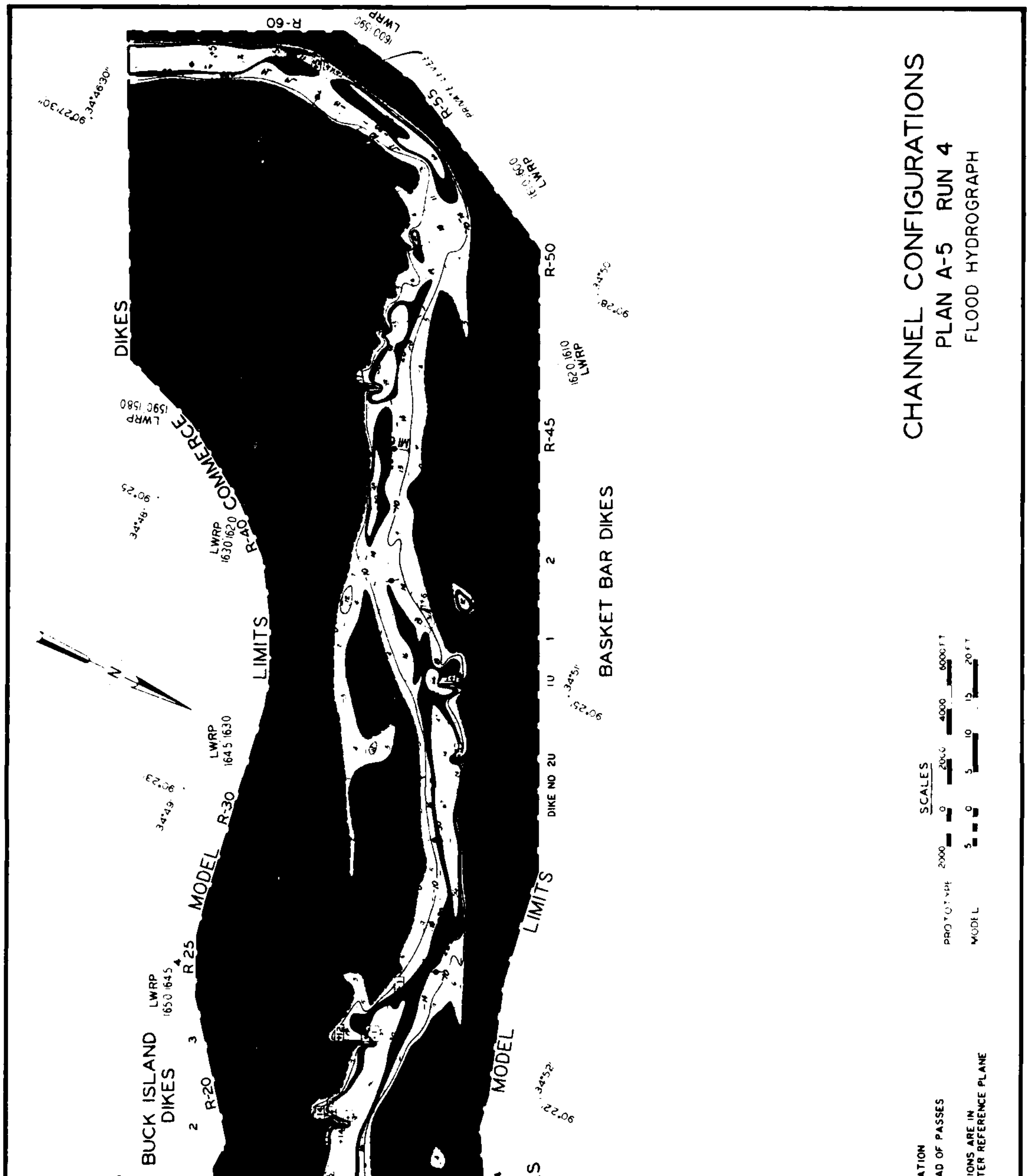
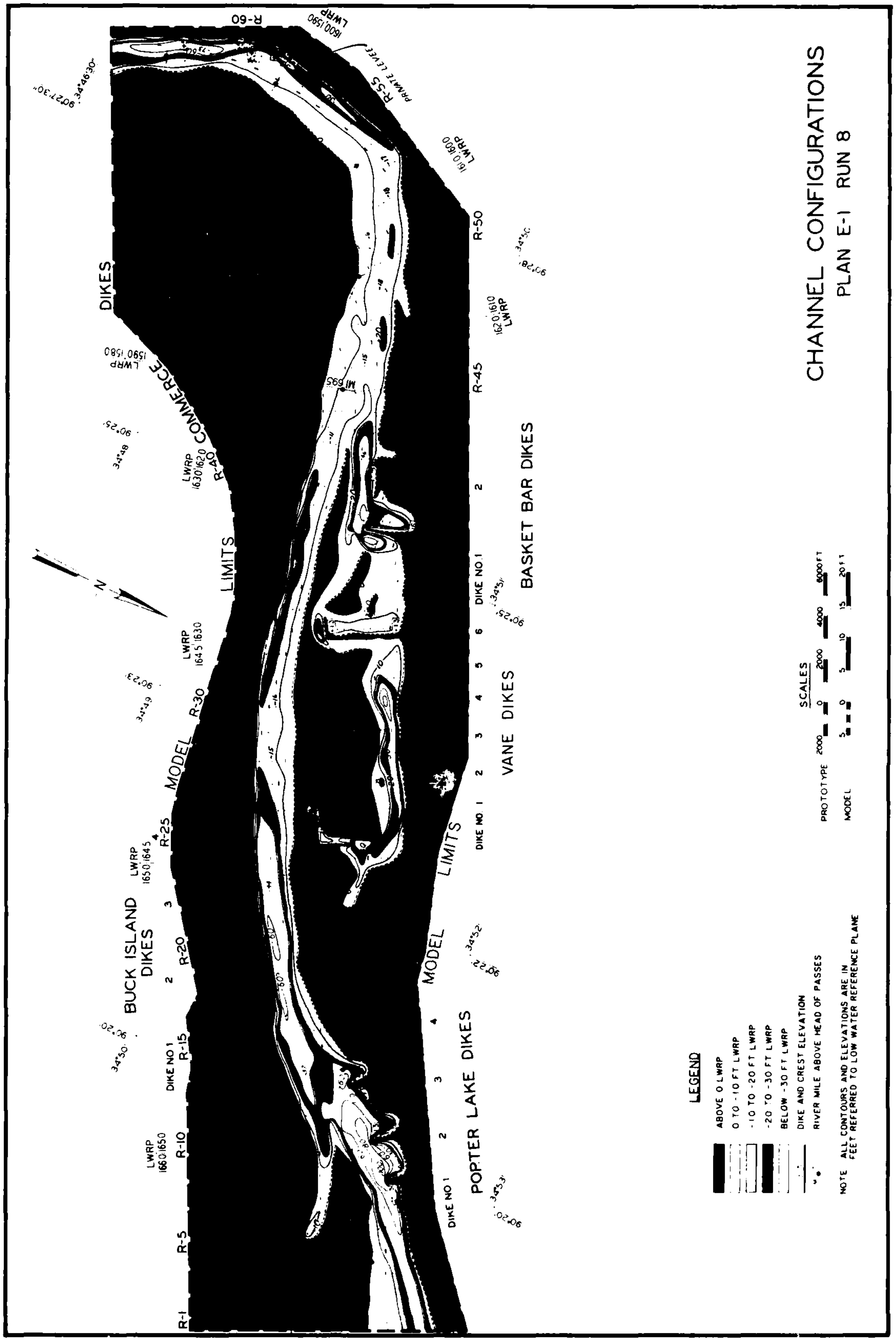
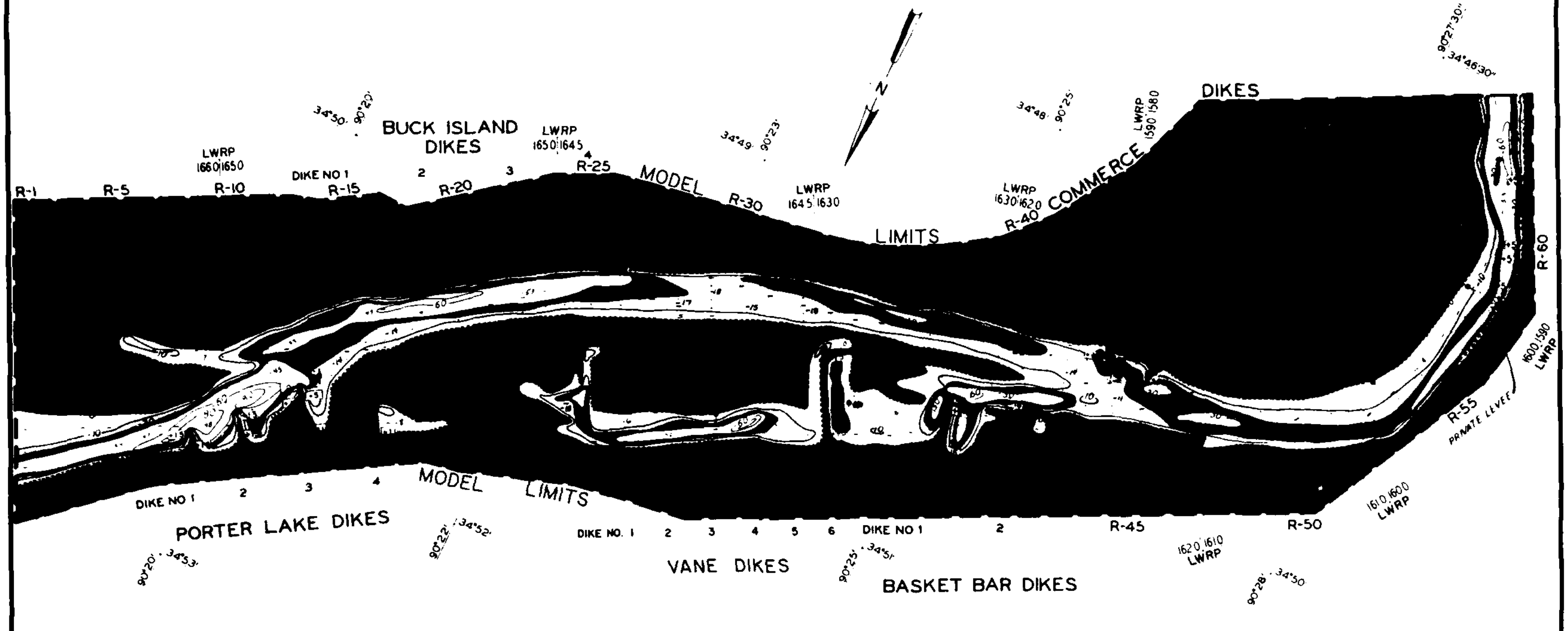

CHANNEL CONFIGURATIONS
PLAN A-5 RUN 4
FLOOD HYDROGRAPH
LEGEND
ABOVE 0 LWRP
0 TO -10 FT LWRP
-10 TO -20 FT LWRP
-20 TO -30 FT LWRP
BELOW -30 FT LWRP
DIKE AND CREST ELEVATION
RIVER MILE ABOVE HEAD OF PASSES
NOTE ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO LOW WATER REFERENCE PLANE
SCALES
PROTOTYPE
MODEL
N
BUCK ISLAND DIKES
PORTER LAKE DIKES
BASKET BAR DIKES
MODEL LIMITS
COMMERCE DIKES
DIKE NO 1
DIKE NO 20
R-1
R-5
R-10
R-15
R-20
R-25
R-30
R-40
R-45
R-50
R-55
R-60
LWRP

PLATE 16



CHANNEL CONFIGURATIONS
PLAN E-1 RUN 8
COMMERCE DIKES
BUCK ISLAND DIKES
POPTER LAKE DIKES
VANE DIKES
BASKET BAR DIKES
MODEL LIMITS
PRIVATE LEVEE
LEGEND
ABOVE 0 LWRP
0 TO -10 FT LWRP
-10 TO -20 FT LWRP
-20 TO -30 FT LWRP
BELOW -30 FT LWRP
DIKE AND CREST ELEVATION
RIVER MILE ABOVE HEAD OF PASSES
NOTE ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO LOW WATER REFERENCE PLANE
SCALES
PROTOTYPE 2000 0 2000 4000 6000 FT
MODEL 5 0 5 10 15 20 FT

PLATE 30



LEGEND

- ABOVE 0 LWRP
- 0 TO -10 FT LWRP
- -10 TO -20 FT LWRP
- -20 TO -30 FT LWRP
- BELOW -30 FT LWRP
- DIKE AND CREST ELEVATION
- RIVER MILE ABOVE HEAD OF PASSES

NOTE ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO LOW WATER REFERENCE PLANE

SCALES

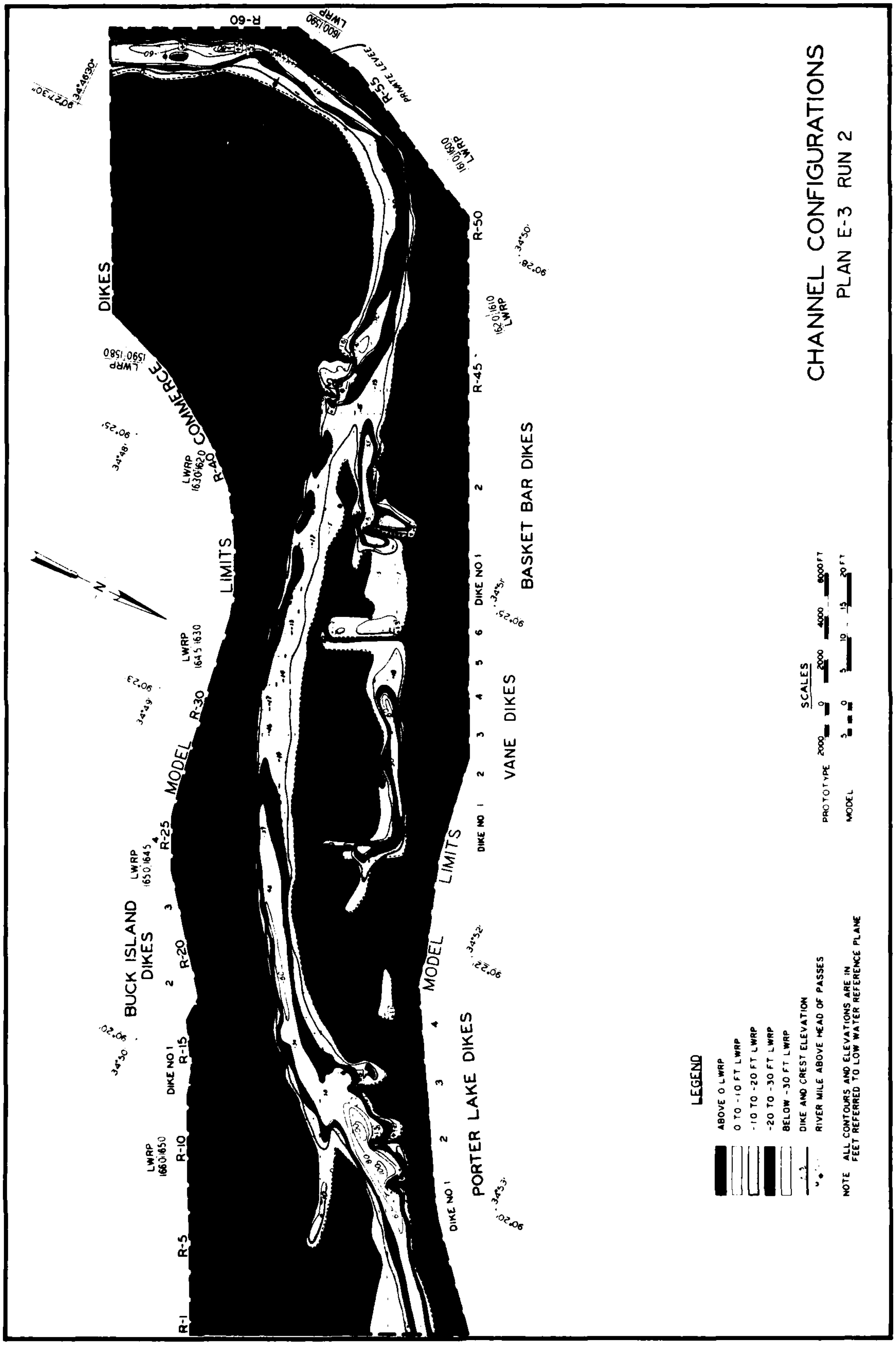
PROTOTYPE 2000 0 2000 4000 6000 FT

MODEL 5 0 5 10 15 20 FT

CHANNEL CONFIGURATIONS

PLAN E-2 RUN 2

PLATE 31



CHANNEL CONFIGURATIONS
PLAN E-3 RUN 2
LEGEND
ABOVE 0 LWRP
0 TO -10 FT LWRP
-10 TO -20 FT LWRP
-20 TO -30 FT LWRP
BELOW -30 FT LWRP
DIKE AND CREST ELEVATION
RIVER MILE ABOVE HEAD OF PASSES
NOTE ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO LOW WATER REFERENCE PLANE
SCALES
PROTOTYPE 2000 0 2000 4000 6000 FT
MODEL 5 0 5 10 15 20 FT
MODEL LIMITS
COMMERCE DIKES
BUCK ISLAND DIKES
PORTER LAKE DIKES
VANE DIKES
BASKET BAR DIKES
PRIVATE LEVEE
DIKE NO 1
R-1
R-5
R-10
R-15
R-20
R-25
R-30
R-40
R-45
R-50
R-55
R-60
LWRP 1660/1650
LWRP 1650/1645
LWRP 1645/1630
LWRP 1630/1620
LWRP 1590/1580
LWRP 1620/1610
LWRP 1610/1600
LWRP 1600/1590
N

PLATE 32

END

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8-85

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